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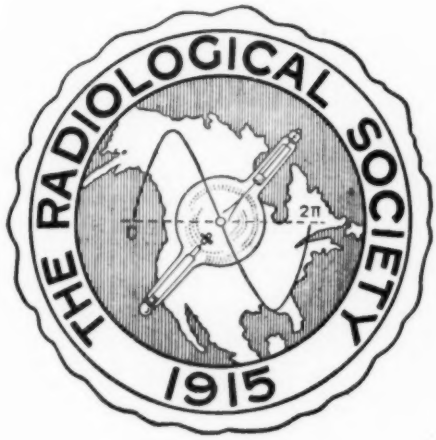
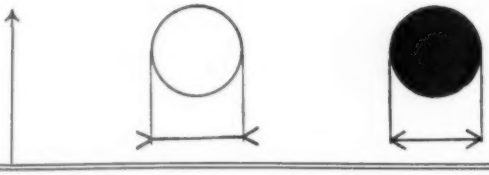
THE JOURNAL OF RADIOLOGY

VOL. III NOVEMBER, 1922 No. 11



PUBLISHED MONTHLY BY
THE RADIOLOGICAL SOCIETY
OF NORTH AMERICA
AT OMAHA, NEBRASKA



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The Inheritability of Spontaneous Cancer in Mice and Its Application to Cancer in Man*

Studies in the Incidence and Inheritabilty of Spontaneous Cancer in Mice

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A PROBLEM in heredity is not a simple problem. The layman, both scientific and unscientific, is accustomed to think of the offspring of two individuals as being an inheritance compound of the qualities of these two only, with emphasis perhaps upon the characters of the one or of the other, forgetting that *behind each parent lay a long ascent of determining ancestry.* Unless, therefore, an individual is the product of generations of inbreeding of other individuals bearing characters exactly similar to his own, he is a heterogeneous complex of what he can transmit to his immediate offspring in any cross.

There are constantly appearing in scientific and medical journals today, both in this country and abroad, articles on the inheritability of some disease or pathologic condition, based on a study of the diseases of the immediate parents only. The conclusions of the authors for or against the heredity factor in any given pathologic condition is based on this study of the parents alone, whereas the slightest acquaintance with the basic laws of heredity would show that such a limited investigation makes a correct conclusion impossible.

The long continued process of mixed hybridization, typical of the human race, makes a problem difficult of analysis. With our present complete lack of scientific data concerning the ancestry of any human individual, *the problem of the inheritability of any disease whatever is a problem impossible of scientific solution by the use of human statistics. This present impossibility of solving the problem by the use of human statistics in no way influences the inevitable operation of the laws of heredity in the human species as exactly as in any other species.*

Because, therefore, we have no scientific data with which to study the problem of heredity in the human species, nor any possibility of the collection of such data at any period in the near future, it is necessary that the facts of heredity and its method of operation should be studied by means of animals in the laboratory, where it is possible to establish a complete biologic control, and absolutely to isolate thereby the single factor of heredity. This latter can in no measure be done in regard to any subject whatever in the present status of human statistics.

The problem of the nature and inheritability of spontaneous cancer has been under study in this laboratory for the past twelve years, and for ten years the results of these studies have been in published form. During this time a more complete and more fundamental mass of facts has steadily accumulated, as it has been possible to analyze strains and individuals more and more completely.

One of the facts consistently demonstrated in these studies is the inheritability of spontaneous cancer, with its strong evidence against the possibility of cancer being a specific germ disease. Among the many thousand mice bred in this laboratory and the hundreds of strains derived thereby, there has been no case which does not agree with this conclusion, no appearance of spontaneous cancer in any non-cancer strain, nor any line into which cancer has been bred where it has not appeared in exact accordance with the known laws of heredity. The inheritance behavior of cancer has consistently been that of a simple Mendelian recessive, and at the same time, the behavior of the non-cancer tendency has consistently been that of a simple Mendelian dominant. It is therefore a demonstrated fact that spontaneous cancer is inheritable in mice, and this fact is now pretty generally conceded.

The profound and biologic aspect of this demonstration, however, has for the most part failed to be grasped by the medical world, and the object of this paper, therefore, is to emphasize that phase of the study, and to make clear the exact application of this demonstration to the problem of the inheritability of cancer in man.

Every instance of organic behavior is based on biologic law. It is contrary to every biologic analogy to say that because we have not yet discovered it, there is no law for any given type of organic behavior. Many of these laws and their ramifications are as yet not even foreshadowed. In the case of the law of heredity, however, which is the most fundamental and most potent of all biologic laws, we have the fundamental facts. But although we have these facts, we continue in personal opinion and in actual practice for the most part entirely to ignore them.

What is heredity? If you consult the dictionary you will get some such definition as this: "Heredity, the law according to which plants and animals inherit and transmit from generation to generation certain characteristics or tendencies." But if we give it its full biologic definition, we must say: "*Heredity is the force which makes and holds together the genus and the species.*" It determines that fish shall have fins, and a special apparatus to filter air out of water, and for the specific fish it determines a certain arrangement of scales, a given size, a given egg-laying habit, as of the bass, the brook-trout or the salmon. It determines that insects shall have a given type of segmentation like the ancestral form from which they are derived, and for the specific insect it determines a given larval and a given adult form, as has the monarch butterfly, the sphinx moth, the honey bee.

It goes far deeper than this, and determines that the human embryo, be-

*—Presented before the Radiological Society of North America, St. Louis, May 20, 1922; also before the American Society for Cancer Research, Washington, D. C., May 1, 1922, and before the National Academy of Science, Chicago, November 15, 1921.

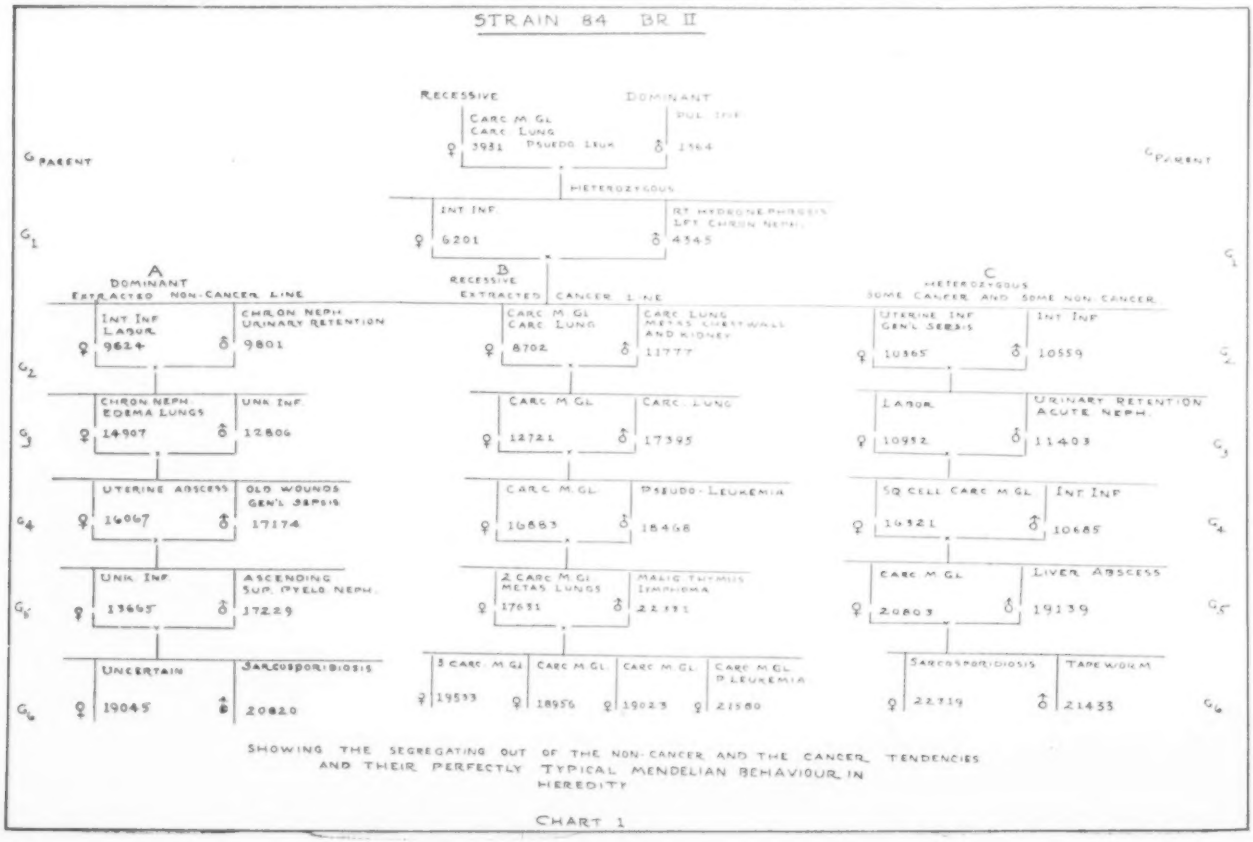
ginning with a single cell, like any unicellular animal or plant, shall divide in the same way, and in its complex cell division and differentiation recapitulate in hurried fashion the history of organic evolution.

Why? Let me here state, as I have already stated in a previous article, what I conceive to be the biologic law of heredity, the law which underlies all life: *That which goes into the germ plasm must come out in the offspring.* We must conceive of this simple law as being as absolute and as immutable as a fundamental law of physics: what goes up must come down; or a law of chemistry: sulphuric acid on zinc will produce zinc sulphate. If you pour acid on metal you will get a given reaction whether you want it or not. What goes into the germ plasm comes out in the offspring whether you want it or not—a law of nature, immutable, deaf to entreaty.

Now the unique feature of natural law is that we cannot break it. We can study it, learn to understand it and work with it, or we can continue to ignore it and combat it and be broken by it; but we cannot break it or change it—only so does the organic world hold together. It is a general law, this law of heredity, not one law for a mouse and another for a man, another for a guinea pig, and another for a geranium, but one common law of heredity—what goes into the germ plasm comes out in the offspring, whether it is the seed of a geranium, the ovum of a guinea pig or of a man. And in the progress of evolution, we see the constant and unbroken control of heredity, so that man, the latest produce of evolution, starts with a single cell, recapitulates in his embryonal growth the history of organic evolution, and in his turn sets off the single cell, the germ plasm, made of the stuff he received from his ancestry. He puts into it the identical material, which in its turn again divides and in its embryonal development briefly recapitulates organic history and in time becomes the finished example of the species. He is made of the material received from his ancestry, and of this alone—his general build, his length of leg, his shape of nose, his hair color, the kind of kidney he has, and the kind of liver he has, and the kind of lungs and heart he has, the kind of epithelium he has and the kind of connective tissue, and the kind of endothelium. He starts with vague nose shape, but it will grow into the nose shape of his ancestors. He starts with tiny legs, but they will grow to the inherited length. He inherits a liver which will in time react like the livers of his ancestors to the same causes. He inherits a type of epithelium and of connective tissue which will in time react like the epithelium and the connective tissue of his ancestors to the same causes.

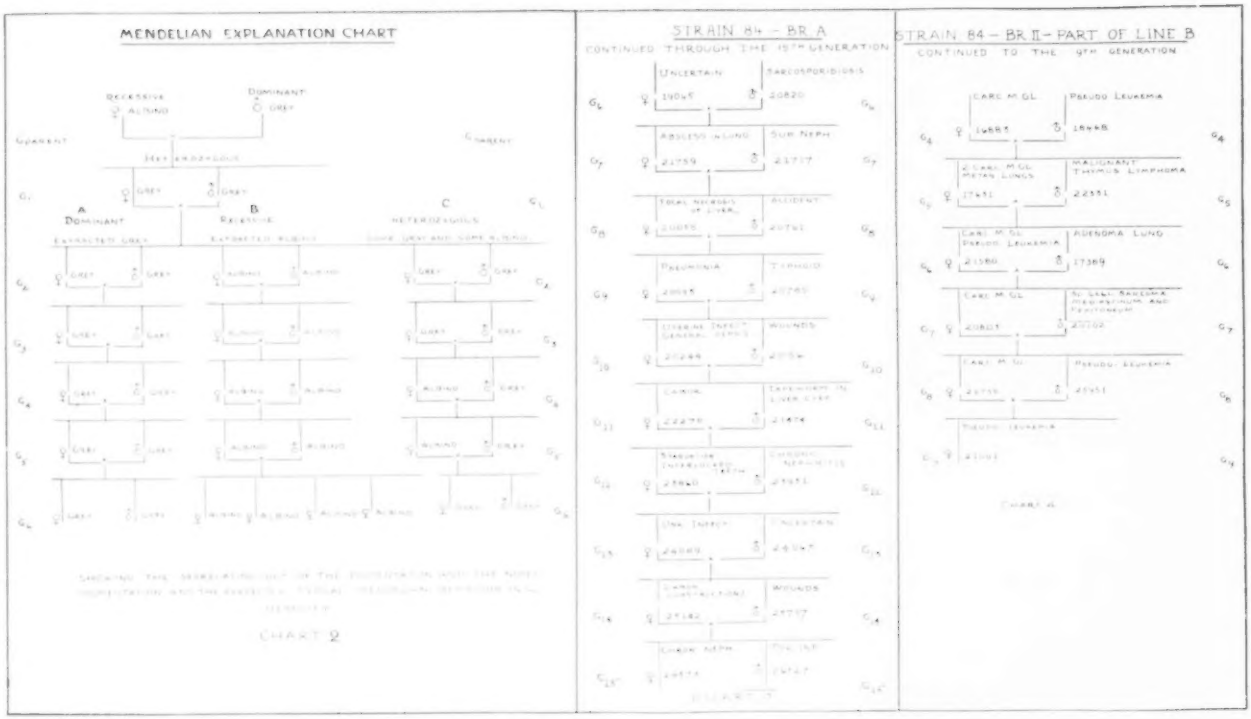
So much for the general, the immutable law of heredity—what goes into the germ plasm comes out in the offspring.

How does heredity work? As long ago as 1865 Mendel worked out with green peas the best study of the method of heredity that we have ever had. Later, and following him, Cuenot and others worked it out with mice, and it worked out with mice exactly as perfectly as it worked out with peas. Now it is vastly further in the scheme of evolution from peas to mice than it is from mice to man. Mice are mammals like man; their structure is like man's—a head, a trunk, four limbs. Their organs are like man's, arranged in the same relation to each other, made out of the same types of materials, functioning in the same way for the maintenance of the organism. If we cut a mouse's arm it bleeds like man's, and then regeneration sets in as it does in man, the edges draw together, the epithelium proliferates, scar tissue is formed, which eventually, either in part or in whole, is absorbed—a process identical with that of man's tissues, functioning like those of a man, just as the geranium does if you cut it. Why? The law of heredity, transmits a type of protoplasmic behavior down the full line of evolution; similar tissues function in the same way because they were derived from a common ancestry. If we do not accept this, we must discard the theory of evolution, for this is the heart of the theory of evolution.



SHOWING THE SEGREGATING OUT OF THE NON-CANCER AND THE CANCER TENDENCIES AND THEIR PERFECTLY TYPICAL MENDELIAN BEHAVIOUR IN HEREDITY

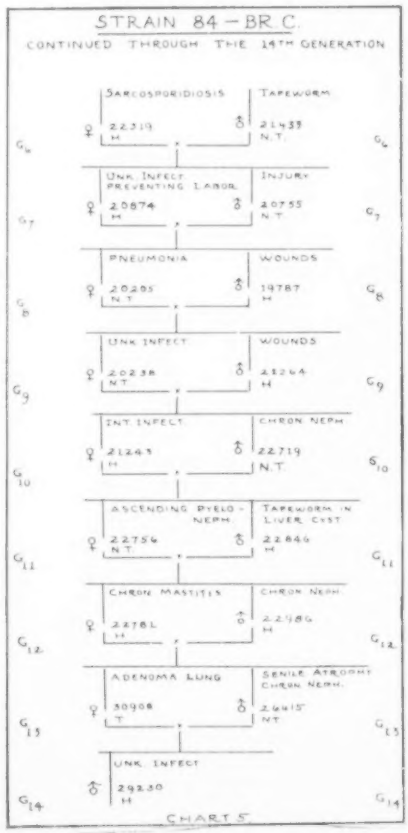
CHART 1


MENDELIAN EXPLANATION CHART
CHART 2
STRAIN 84 – BR A
CONTINUED THROUGH THE 15TH GENERATION
STRAIN 84 – BR II – PART OF LINE B
CONTINUED TO THE 9TH GENERATION

I have here quoted somewhat at length from my article now in press and to appear shortly in the Journal of Cancer Research, because these fundamental biologic facts cannot be too often repeated. Indeed, it seems to be one of the profoundest needs of medical science today that it should adjust itself to these fundamental biologic laws and base itself upon them; and it is one of the pre-eminent aims of the work of this laboratory to assist in setting biology in its relation to pathology and to therapy.

As already stated, the work of this laboratory, carried on for twelve years, and during all that time yielding perfectly consistent results, has shown that the cancer tendency and the non-cancer tendency are some of the characters that go into the germ plasm and inevitably come out in the offspring of mice in exact accordance with the basic laws of heredity. Therefore, unless we state that there is no such thing as biologic unity or organic law, we must admit that these are characters which go into the germ plasm, and therefore come out in the offspring of man in exact accordance with the basic laws of heredity.

Now the method of heredity, as worked out by Mendel, and repeated with mice by Cuenot is this: When a purebred house mouse, grey, is crossed with a purebred albino, the first hybrid generation will all be gray. That is, the tendency to pigmentation is dominant over the tendency to the lack of pigmentation. Now if we mate two of these first generation hybrid greys (heterozygotes) we shall get in the second hybrid generation some purebreeding greys (dominants), some heterozygous greys and some albinos (recessives) in the proportion of one to two to one. These dominant greys, if bred together or hybridized with other dominant greys similarly derived, will breed true. The recessive albinos whether inbred or hybridized with other purebreeding albinos, will breed true.

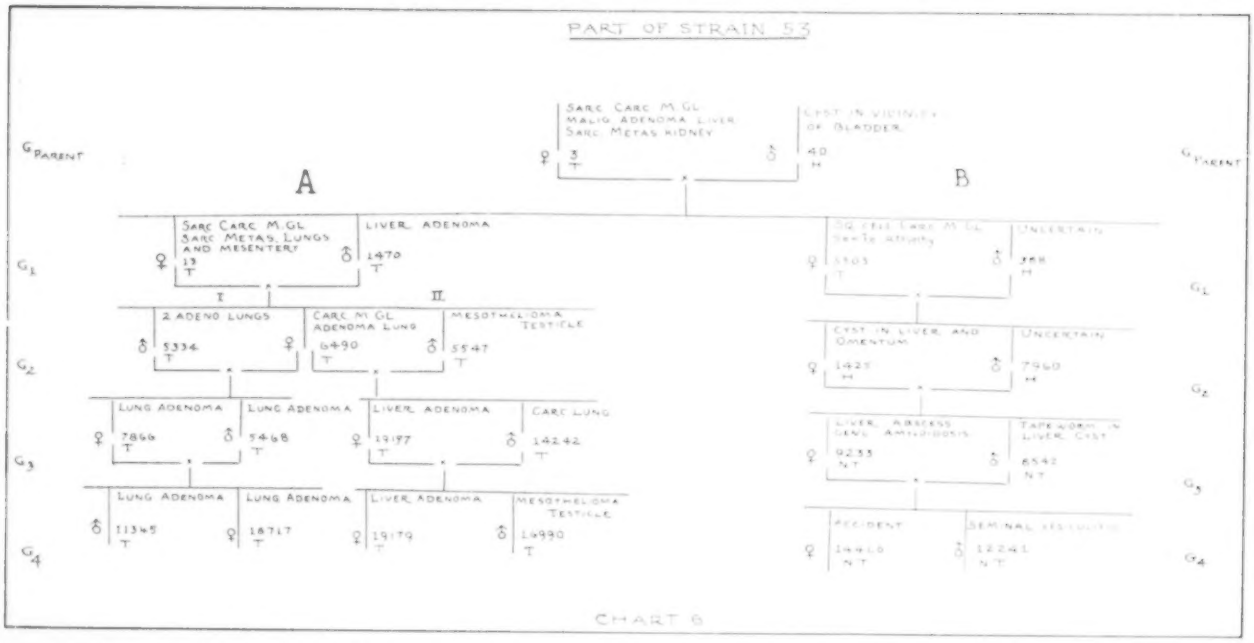


The heterozygous greys, whether inbred or hybridized with other heterozygous greys similarly derived, will again yield the three types, dominant greys, heterozygous greys, and recessive albinos, in the proportion of one to two to one. (See Chart 2.)

Again, if we cross a purebred albino with a heterozygous grey, we shall get, in the first hybrid generation, recessive albinos and heterozygous greys in the proportion of one to one. These albinos will breed true whether inbred or hybridized with other purebred albinos. The heterozygous greys, in this case also whether inbred or hybridized with other similarly derived heterozygous greys, will give the same three types, dominant greys, heterozygous greys, and recessive albinos.

Again, if we cross a dominant grey with a heterozygous grey, the first hybrid generation will give dominant greys and heterozygous greys in the proportion of one to one. The dominant greys will breed true, and the heterozygous greys will again give the same three types.

Why do these characters behave in this way? That they do is certain. What is the secret of the method of heredity? If we mate two purebred albinos the offspring will all be albino; that is, there will be a complete lack of the pigment-making mechanism. Pigment is an absent character in these individuals. It did not go into their germ plasm and they cannot transmit it to their offspring. If only albino mice are allowed to breed, the pigment-making mechanism will be lost for mice and cannot be recovered, and there will

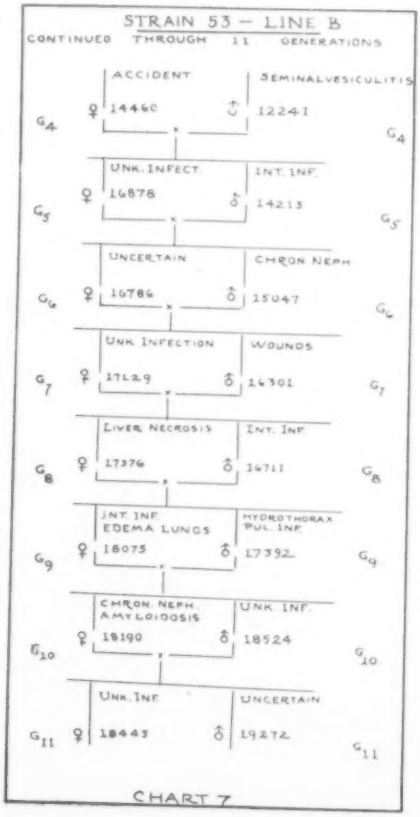


thereafter be only albino mice. Albinism is a recessive character. Purebred albinos cannot transmit the dominant.

Now, if we mate the same purebred albino, into whose germ plasm no pigment-making mechanism went, with a grey house mouse into whose germ plasm the tendency to pigment-making mechanism did go, we shall get in the first hybrid generation, heterozygous greys, that is, pigment-making is dominant over the lack of pigment-making, therefore the mice are grey. But into their germ plasm went from one side the absence of the pigment-making mechanism (as a unit character), and from the other side went the presence of the pigment-making mechanism (another unit character); so, since both these unit characters went into their germ plasm, both of these characters will come out somewhere in the offspring—the law of heredity.

All efficient study of heredity is the study of the behavior of unit characters. Only we must be sure that we have analyzed our characteristics into unit characters, which segregate out and are transmitted as such, like albinism and pigmentation, spotting and self-color, etc. And conversely when in the study of heredity we have found a character which does segregate out and is transmitted as such, we have found a unit character, which will behave in accordance with the immutable law of heredity for the unit character. A unit character is then to heredity what an electron is to chemistry—incapable of analysis, it segregates out and is transmitted as such.

Now, when we are dealing with a complex organism, like a man or a mouse, there is a multiplicity of these unit characters which have gone into his germ plasm from his ancestors, and which will get into all possible combinations, for example, a tendency to a heavy and a tall skeleton; a tendency to a particular length in the limb; a tendency to blackness of hair with a tendency to curliness of hair; a tendency to a straight nose with a tendency to a large nose; a tendency to a certain kind of liver, which will tend to a certain type of epithelium, with a tendency to a certain type of behavior, etc.—all unit characters.



Every organism then is a synthesis of unit characters, which cannot be correctly manipulated or interpreted in experimental work with accurate results, until it has been analyzed into its component unit characters. Until the truth of this fact has come home to the experimental biologist, pathologist, bacteriologist and student of therapy, our results are certain to be invalidated by artifacts. This applies in all experimentally produced cancer, whether by grafts or by artificial chronic irritations like painting with coal tar products, and feeding with nematode and tapeworm larvae, just as it applies everywhere else in experimental research. First by analyzing our stocks into unit characters, we must learn what portion of the result is produced by nature without reference to the experiment, and what is the experimental residuum.

With these things in mind, I undertook the study of the heredity behavior of cancer, to find out the nature of cancer; partly in order to learn how to get rid of a hideous disease, and partly for the light such a study must throw on general biologic problems of all tissue behavior. I proceeded to study the inheritability of neoplasms in exactly this classic way, that is, by making a biologic analysis of stock without which no stock is of any value for conclusions concerning heredity, or practically anything else.

In order to make a biologic analysis of stock, it is necessary to breed it out so as to find out what unit characters went into its germ plasm. It then becomes a stock made up of analyzed individuals, whose hereditary potentialities are known and whose effect in any cross can be predicted. On the other

hand, if you buy animals in the market and proceed to use them for even a simple experiment, they are worthless until they are analyzed, because some of them may be purebred and some of them inevitably will be heterozygous in many respects, and they will not behave alike in any given experiment, since they have not the same unit characters. You have no biologic control in the experiment until each animal to be used has been analyzed.

In the study of the inheritability of cancer, then, having first made a thorough biologic analysis of stock by hybridization and by inbreeding, I found that equally by the method of hybridization and by inbreeding, if you mate two mice having carcinoma of the lung (primary or secondary) you can extract from them a strain of 100 per cent lung tumor mice. Again, by mating two mice having mammary gland carcinoma, a strain of 100 per cent mammary gland carcinoma mice can be extracted from them, etc. That is, both in inbreeding and in hybridization, the cancer tendency and the non-cancer tendency behave like unit characters, that is, they segregate out and are transmitted as such.

I tried also further tests of hybridization between cancer mice and absolutely non-cancer mice. By a cancer mouse we mean a mouse whose ancestry had cancer, into whose germ plasm the cancer tendency entered, and who himself has cancer. By a non-cancer mouse we mean a mouse which came from wholly non-cancer ancestry, into whose germ plasm there went the tendency to the absence of cancer, and who therefore cannot transmit it to his offspring. They are analyzed individuals, both of them, whose heredity behavior in the matter of cancer can be predicted.

If I mate such a non-cancer mouse with a cancer mouse, into the common progeny of these two there goes (1) a tendency to cancer, and (2) a tendency to the absence of cancer; and the first hybrid generation can, and infallibly does, transmit some of both these tendencies. *But cancer is recessive to non-cancer, and so the first hybrid generation shows none of it, and throughout my entire experience never has shown in it a single case; but the tendency to cancer segregates out, and in the second hybrid generation it appears again, in the same organs and in the same tissues of those which show the ancestral tumors.*

CHART 1

Note Chart 1, showing three lines derived from Strain 84, Branch II. This chart is perfectly typical. The parent female, 3931, died of carcinoma of the mammary gland, carcinoma of the lung and pseudoleukemia. She was *hybridized* with absolutely non-cancer male 1364, who died of pulmonary infection. In accordance with the Mendelian expectation from such a cross, no cancer appears in the first hybrid generation. Cancer is recessive to non-cancer. For the parents of this branch of the family, female 6201 and male 4345, both heterozygotes, were selected.

Note how there were extracted from this hybrid cross three lines of mice: (A) the dominant, which neither in direct descent nor in any accessory fraternities, ever showed one case of neoplasm, malignant or benign; (B) the recessive line, 100 per cent malignant disease, and (C) the heterozygous line showing both cancerous and non-cancerous individuals. Note how the same types and locations of neoplasms which were bred into the strain with parent female 3931, segregate out and are transmitted as such wherever tumor occurs, both in the recessive, 100 per cent cancer line B, and in the heterozygous line C, namely, carcinoma of the mammary gland, carcinoma of the lung, pseudoleukemia, and its closely related tumor type, thymus lymphoma.

It is interesting to note that in the animals of this stock, chronic leukemia and pseudoleukemia (alymphatic leukemia, not lymphogranulomatosis) have occurred only in the cancer strains and have behaved as if they were true neoplastic diseases. As yet we have not analyzed this material and are not prepared to discuss the matter further than the mere statement of the fact, which

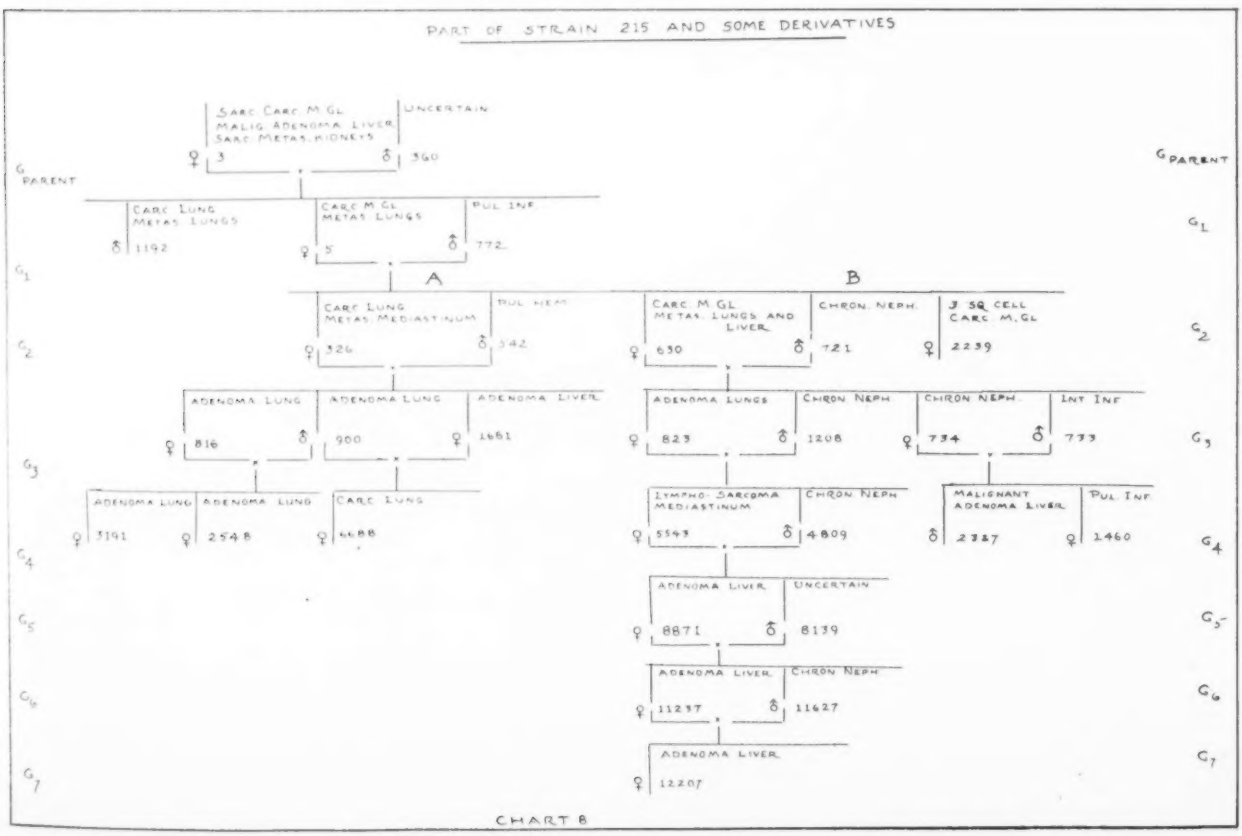


CHART 8

is in support of the contention of many pathologists, that chronic leukemia and pseudoleukemia are as much true neoplasms as are lymphosarcomas.

Chart 1, then, shows the segregating out and the transmission as such of the non-cancer and the cancer tendencies, also the tendency to a specificity of tissue type, which locates the neoplasm in a certain organ, and their perfectly typical Mendelian behavior in heredity as unit characters.

Chart 2

Note how exactly this follows the Mendelian expectation, as shown in Chart 2, giving the classic behavior where a hybrid cross is made between the recessive albinism and the dominant pigmentation. Here also three lines are extracted, individual for individual, parallel with those shown in Chart 1, namely (1) a dominant line A, in which albinos never occurred either in the direct descent or in the accessory fraternities; (2) a recessive line B, 100 per cent albinos, in which no pigmented individual ever appeared, and (3) a heterozygous line C, showing some albinos and some pigmented mice.

Chart 2, then, shows the segregating out and the transmission as such of the pigment-making tendency and the lack of the pigment-making tendency, and their perfectly typical Mendelian behavior in heredity as unit characters. That is, the pigment-making tendency and the non pigment-making tendency behave in the matter of heredity just as did the cancer and the non-cancer tendencies shown in Chart 1.

Chart 3

Chart 3 continues part of Line A extracted from Strain 84, Branch II, *through the fifteenth generation without the occurrence of a neoplasm of any sort.* This shows the absolute segregating out and the transmission as such of the non-cancer tendency. When a non-cancer line has once been extracted spontaneous neoplasms have never, throughout my entire experience, occurred in such a strain again, unless cancer has again been hybridized in from an outside source. Never in Line A nor in any accessory fraternities has a neoplasm of any sort whatever occurred.

Chart 4

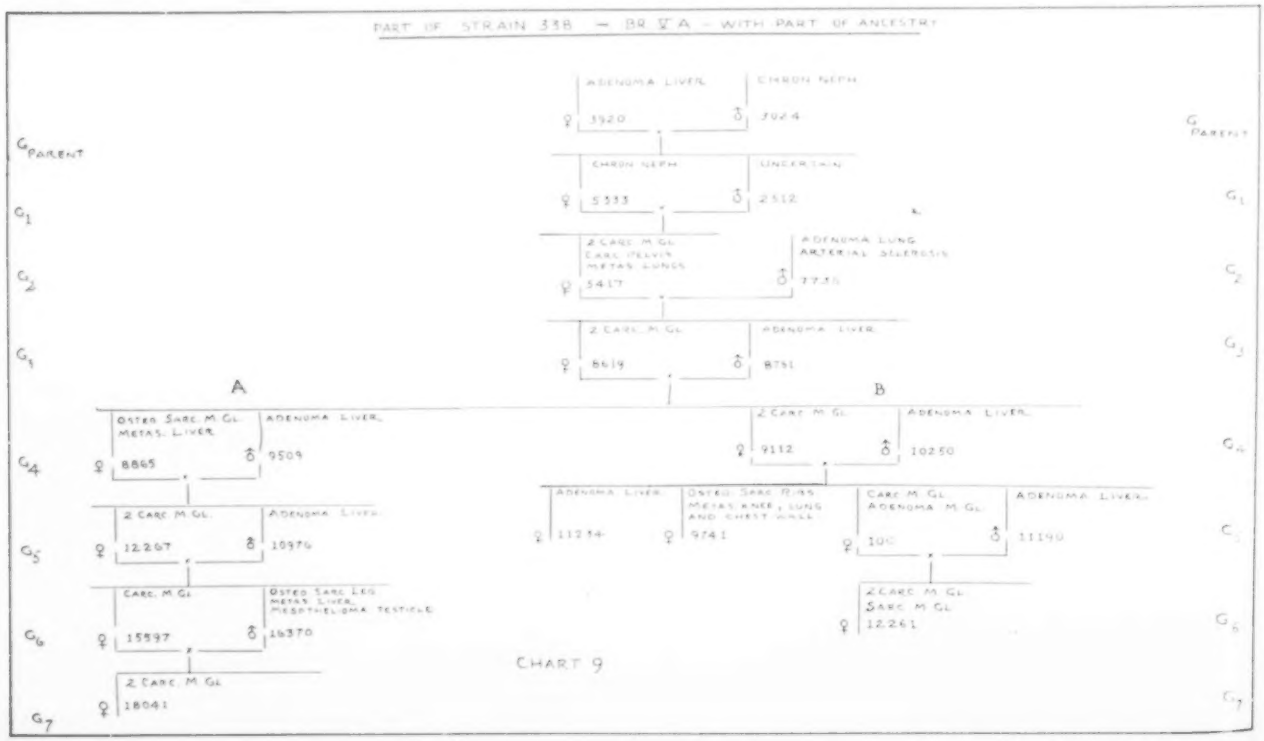
Chart 4 continues Strain 84, Branch II, Line B through the ninth generation. This is the 100 per cent line extracted from this same cross which yielded the 100 per cent non-cancer strain shown in Chart No. 3. Note how the types and locations of the neoplasms occurring in this line of the strain are the same as those bred into it in the original cross, from female 3931, namely, carcinoma of the mammary gland, carcinoma of the lungs, and pseudoleukemia with its closely related tumor type, thymus lymphoma. Note female 21580 in generation six with the carcinoma of the mammary gland of her grandmother and the pseudoleukemia of her grandfather. Note also the interesting sequence here of pseudoleukemia and thymus tumors through six consecutive generations, following the selection of male 18468 as the parent male in generation four. Note also that the original parent female 3931 (shown in Chart 1) had pseudoleukemia along with carcinoma of the mammary gland and primary carcinoma of the lung. Note male 20102 in generation six, with a spindle cell sarcoma of the entire mediastinum and of the peritoneum. This single case of sarcoma was derived from an ancestor several generations antecedent to female 3931, the parent of Strain 84. Lack of space prevents the showing of this ancestral sequence in the single chart.

Chart 5

Chart 5 continues Line C of this same strain through the fourteenth generation. This is the heterozygous line. Note how, by the continued selection of a heterozygous individual for mating with a non-cancerous mate (as indicated by "H" and "N.T." in the chart) all occurrence of neoplasms was held off until the thirteenth generation. Here, by the mating of two mice heterozygous to lung tumor, lung tumor occurred in the thirteenth generation, the parents concerned being female 22781 and male 22986. Lung tumor is one of the tumor types carried by this line. *By the right selective breeding in any heterozygous line, neoplasms can be made to occur or can be held off at will.*

Chart 6

Chart 6 shows part of Strain 53, Line A branching into two extracted 100 per cent tumor families, and Line B, from the same parents, developing into a 100 per cent non-cancerous family. The heterozygous line is not



shown in this chart, owing to lack of space. Note how, in Line A, Family I, a 100 per cent lung adenoma family is being extracted by the selection, as parents of the family, of two mice with lung adenoma, namely male 5334 and female 6490; while in Family II of the same Line A, liver adenomas and mesotheliomas of the testicle are the prevailing tumor types; there being four liver adenomas in the ten individuals forming the direct descent of these five generations.

Note that in Line B after the first hybrid generation (female 5303 with a squamous cell carcinoma of the mammary gland) there was no further appearance of tumor. By the continued selection of non-tumorous individuals after the second filial generation, all neoplasms were completely ruled out of this branch of the strain.

Note female 13 of filial generation 1, Line A, with a sarcoma-carcinoma of the mammary gland like her mother, female 3, and with secondary sarcomas in the lungs and mesentery. Note how with her secondary lung tumor she was able to start a 100 per cent lung tumor line, the secondary lung tumor being as efficient as a primary lung tumor in transmitting lung tumor potentiality. This point is discussed at length in a previous report. (16)

Note the prevalence of cyst and abscess formation in Line B of Strain 53, although in no case do these cysts or abscesses lead to tumor formation in this family. The offspring is made of the identical material of the germ plasm of its ancestry, and its tissues behave in the same way.

Chart 7

Chart 7 shows Line B of this strain continued through the eleventh generation without the occurrence of neoplasms. Never, either in the direct descent or in any accessory fraternity did a neoplasm of any kind occur in this branch of Strain 53 after the neoplastic tendency had once been bred out from the second filial generation.

Chart 8

Chart 8 shows part of Strain 315 and some derivatives. Note the 100 per cent lung tumor strain being extracted in Line A from female 5 with secondary carcinoma of the lung. Note the 50 per cent liver adenoma strain being extracted in Line B. Strain 215 was made by the mating of female 3, who had a sarcoma-carcinoma of the mammary gland, a malignant adenoma of the liver and sarcoma metastasis in the kidney, with male 360, who was proved heterozygous to lung and mediastinal tumors. Note how the different types and locations of neoplasms introduced by these two parents segregate out and are transmitted as such in the succeeding strain.

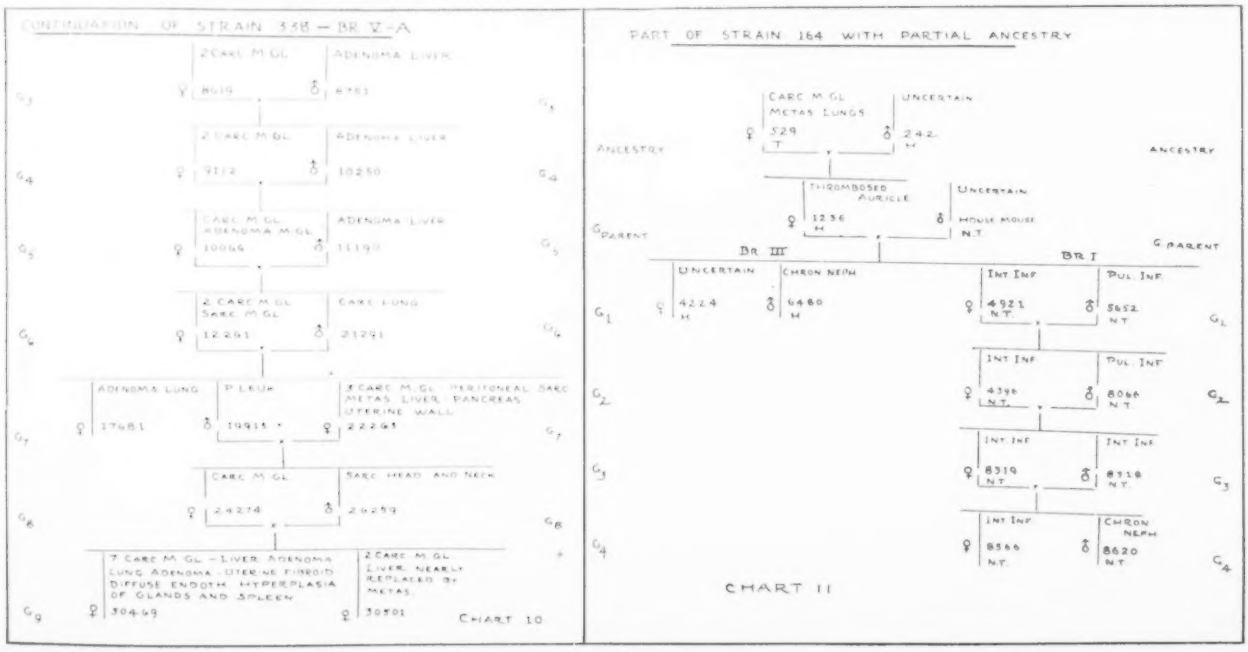
Charts 9 and 10

Charts 9 and 10 show part of Strain 338, Branch V, with partial ancestry, and its offspring carried through the ninth generation. The original ancestor of this strain also was female 3, already referred to in Chart 8. She had a sarcoma-carcinoma of the mammary gland, a malignant adenoma of the liver and sarcoma metastasis in the kidney. Note the striking outcropping of liver tumors in this strain. Note how the different unit characters, sarcoma, carcinoma, and specificity of liver tissue type, get into all possible combinations in the strain, so that even in the small number of individuals represented in these two charts, we find carcinoma of the liver, sarcoma of the liver, both primary and secondary, and adenoma of the liver.

That is, the carcinoma tendency segregates out and is transmitted as such. The sarcoma tendency segregates out and is transmitted as such. The adenoma tendency segregates out and is transmitted as such. A specificity of liver tissue which will insure its yielding to neoplasms, segregates out and is transmitted as such. These are all unit characters, and they get into all possible combinations even in this one small family alone.

I have from necessity selected only a few strains for the charts in this report. They are perfectly typical, however, and are representative of the hundreds of other strains, tumorous and non-tumorous, inbred and hybridized, which have been produced by selective breeding alone, and which have been analyzed in this laboratory for the past fifteen years. I have, therefore, been able to express the matter in little more than outline, and there are many and diverse ramifications of the work, which, for the sake of unity, I cannot enter into at all at this time. But certain facts have consistently obtained in this work for twelve years, and these I wish to emphasize with their application.

Cancer and non-cancer have behaved consistently just as true albinism and pigmentation do in heredity. That is, just as true albinism is the total absence of the pigment-making mechanism present in the pigmented mouse, so spontaneous cancer consistently behaves as though there were absent a mechanism fitted to control proliferation and differentiation in regenerative processes. At any rate, whether or not it is exactly this, it seems to be the absence of



some controlling mechanism, and an animal either has it or does not have it, whether he is a mouse or a man.

Whenever spontaneous cancer comes out in a strain, it is because it has been bred in, in some degree; and however remote the cancer ancestry we shall find it, if we analyze far enough. *Moreover, we shall find not only the neoplastic ancestor, but the ancestors that carried the same types and the same locations of neoplasms shown in the later generations.*

There is no appearance of spontaneous tumor in any non-tumor strain. There are all percentages of cancer, some even as low as .01 of 1 per cent, in varying cancer strains. That is, cancer and non-cancer behave respectively as though there were absent or present a particular controlling mechanism, and an individual, whether it is a mouse or a man, either has it or lacks it.

The unit characters concerned in the heredity of spontaneous tumors, whether we are dealing with mice, with rats, or with man, are these: (1) A specificity of tissue type from organ to organ, which determines that the liver or the kidney, or the uterus, or the mammary gland tissue, etc., shall be like the tissue of its ancestral organ (from which it was derived) and shall react in the same way to the same cause. For example, liver tumor begets liver tumor, etc. (2) A specificity of epithelium from ancestor to offspring, which will cause it to proliferate without differentiation, and without control, under a given provocation; that is, carcinoma begets carcinoma. (3) A specificity of connective tissue from ancestor to offspring, which will cause it to proliferate without differentiation and without control, under a given provocation; that is, sarcoma begets sarcoma.

Like all other unit characters, the unit characters here enumerated may get into all possible combinations; and we therefore when dealing with fundamentally and completely analyzed stocks, have such a result as shown from female 3. This female 3, with a sarcoma-carcinoma of the mammary gland, a malignant adenoma of the liver, and sarcoma metastasis in the kidney, is able to transmit to her posterity (and has so transmitted) all possible combinations of these unit characters, namely, carcinoma of the mammary gland, sarcoma of the mammary gland, sarcoma-carcinoma of the mammary gland, adenoma of the mammary gland; carcinoma of the liver, sarcoma of the liver, adenoma of the liver; sarcoma of the kidney, carcinoma of the kidney, adenoma of the kidney.

There are only two possible methods of studying the inheritability of any character whatever, cancer or anything else. These are (1) the long, painstaking, difficult analysis of stock in the laboratory, so that we obtain analyzed individuals whose hereditary potentialities are known quantities and can be manipulated as such. This is the method which has been pursued in this laboratory for fifteen years, and (2) the so-called statistical method which has been in vogue in the study of the inheritability of cancer in man.

All human statistics of this nature are based upon two things, both of which may be in error. Namely, the memory of the patient, and the diagnoses concerning his ancestry. Rarely, back of one generation, are the facts accurately remembered or the diagnoses based upon autopsy. We have, then, no certain scientific material whatever to deal with in these statistics. But where these statistics are right, as they frequently even by chance must be, *a biologic reading of them would show that they also demonstrate the inheritability of cancer in man.*

CHART 11

Note Chart 11, showing part of Strain 164 with partial ancestry on the maternal side. Female 1236, who died of a thrombosed auricle (a condition somewhat frequent in this laboratory) was the parent female of this strain. Her mother was tumorous (indicated by "T" in the chart) and died of a mammary gland with metastases in the lungs. Her father, male 242, died of uncertain causes. He did not himself have tumor, but was proved heterozygous to tumor (indicated by "H" in the chart) that is, he inherited it from cancerous ancestry and transmitted it to his offspring, although not himself having tumor.

The male parent of Strain 164 was a purebred house mouse, and died of uncertain causes. He was a member of Strain 358, in my hands many years without the occurrence of tumor of any sort, malignant or benign, in any of its fraternities. He himself was an analyzed, proved non-tumorous mouse (indicated by "N.T." in the chart).

In the first hybrid generation from this cross (namely between a heterozygote and a non-tumorous mouse) no tumor of any sort has ever occurred. Cancer is recessive to non-cancer. In this chart the only members of the first hybrid generation of Strain 164 that are shown, are two pairs, namely female 4224 and male 6480, the parents of Branch III of the strain; and female 4921 and male 5652, parents of Branch I of the strain. Female 4224

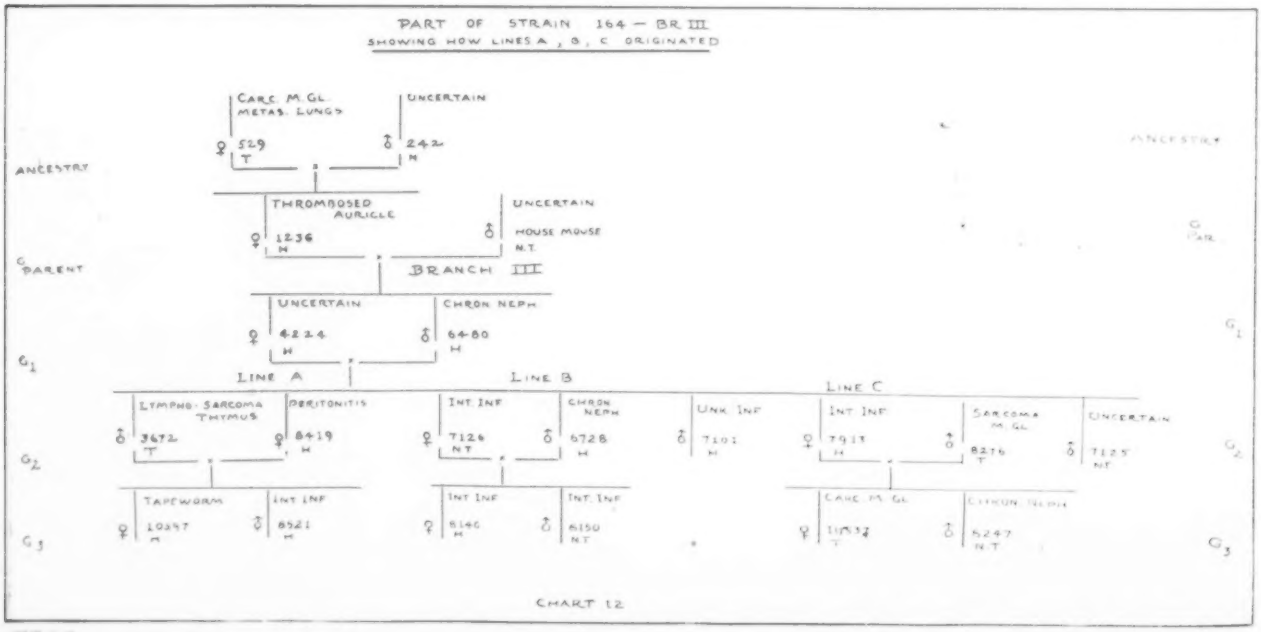


CHART 12

and male 6480 of Branch III were both proved heterozygous to cancer, while female 4921 and male 5652, parents of Branch I were both proved non-tumorous mice.

Note that the progeny in Branch I were all absolutely non-tumorous. Nowhere, either in the direct descent nor in any of the accessory fraternities in this branch of the strain, has there ever been a single occurrence of tumor of any sort, malignant or benign. This is the classic Mendelian behavior to be expected from the mating of two indivduals carrying the dominant, that is, the non-cancer tendency, like female 4921 and male 5652. Branch I, then, of Strain 164, is an absolutely non-tumorous family, every member of which has been analyzed and has proved to be non-tumorous, both in inbreeding and in hybridization; although this branch was derived from cancer ancestry on the maternal side. This shows conclusively that the non-cancer tendency also segregates out and is transmitted as such, and that by the right selective mating the cancer tendency can be ruled out absolutely from a family, beginning with the second hybrid generation.

CHART 12

Chart 12 shows the origin of Branch III of this same Strain 164, and the parentage originating the three lines A, B and C, in which this branch has been bred out. The succeeding charts will show the continuation of these three lines.

The parents of line A were tumorous male 3672, who died of a lymphosarcoma of the thymus, and heterozygous female 8419, who died of peritonitis. Their two offspring selected to carry on this line, were both heterozygous to tumor, namely female 10597, who died of tapeworm, and male 8521, who died of intestinal infection.

The parents of Line B were non-tumorous female 7126 and heterozygous male 6728. Their offspring selected to carry on Line B were heterozygous female 8146 and non-tumorous male 8150, both dying of intestinal infection.

The parents of Line C were heterozygous female 7913 and tumorous male 8276, who died of sarcoma of the mammary gland. Their offspring selected to carry on Line C were tumorous female 10537 with a carcinoma of the mammary gland, and non-tumorous male 8247, who died of chronic nephritis. This chart, then, shows how lines A, B and C of Branch III, Strain 164 originated.

CHART 13

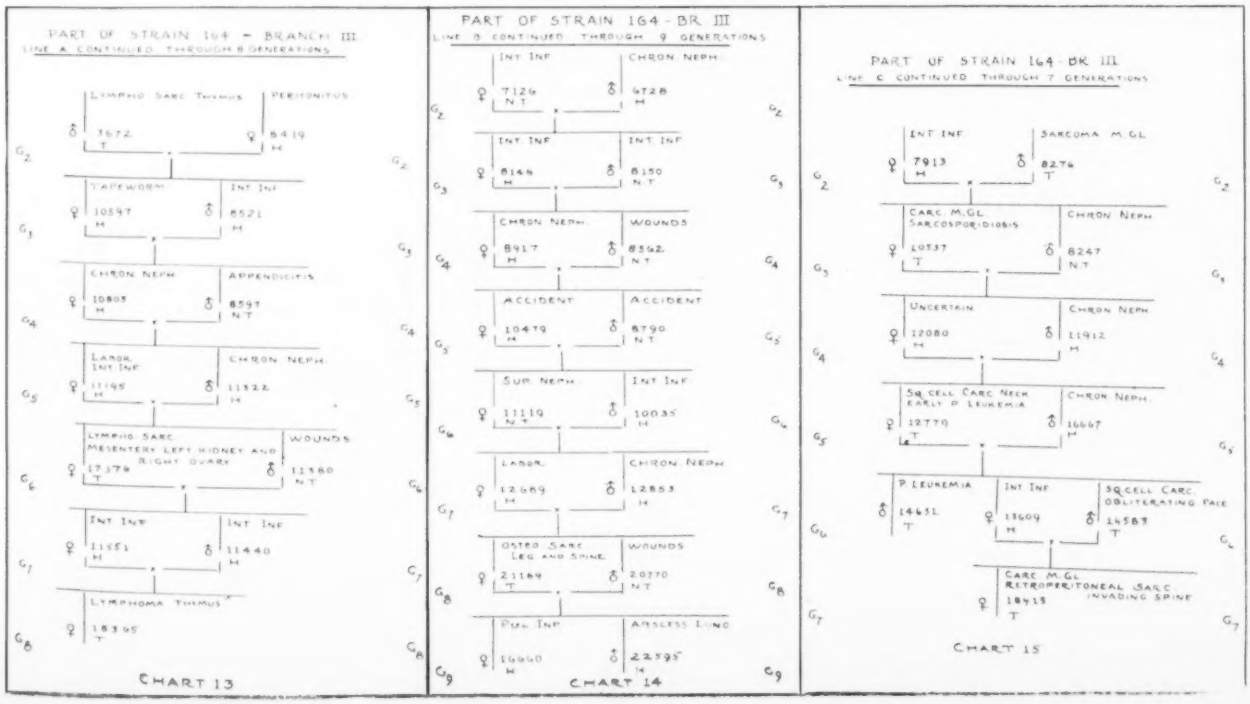
Chart 13 shows Line A of Branch III, Strain 164, continued through eight generations. Note how, by the right selective matings of heterozygous and non-tumorous mice, the occurrence of malignant disease is held off until the sixth generation. If, now, female 12876 with a lymphosarcoma of the mesentery, left kidney and right ovary, had had her statistics taken in the hospital without error, even for three generations, no statistics of tumor would have appeared; nevertheless the inheritance of her tumor type is direct from her grandfather four generations back. By the mating of two heterozygous individuals from this tumorous mother, namely female 11551 and male 11440, again in the next generation a malignant thymus lymphoma occurs in female 18365. At the same time, all other types and locations of tumors are ruled out from this strain, by the right selective matings.

CHART 14

Chart 14 shows Line B of Branch III, Strain 164, continued through nine generations. Note how by continued matings of heterozygous and non-tumorous individuals, all occurrence of malignant disease has been held off until the eighth generation. If female 21189 of the eighth generation, who died of an osteosarcoma of the leg and spine , had had her hospital statistics taken even seven generations without error, there would have been no appearance of tumor. Nevertheless, by tracing far enough back, we find the ancestor with malignant disease. This chart shows with what certainty the tendency to neoplasms can be manipulated and controlled. Through generation after generation it was carried along by heterozygous individuals, certain to appear when the right matings were made.

CHART 15

Chart 15 shows Line C of this branch of Strain 164 continued through seven generations. Here, by mating tumorous female 10537 with proved non-tumorous male 8247, no tumor occurred in the next generation. But by the selection of two heterozygotes of generation 4, carcinoma appeared in the succeeding generation (generation 5) in female 12779 with a squamous cell carcinoma of the neck and pseudo-



leukemia. Again, by the mating of this female with heterozygous male 16667, note how both pseudoleukemia occurred in the next generation, male 14631, and also squamous cell carcinoma of the neck, which at death had extended anteriorly and obliterated the face, male 14583. Female 18413, daughter of male 14583, showed the carcinoma of the mammary gland of her grandmother four generations back and the sarcoma of her grandfather five generations back. When a given type or location of neoplasm is bred in, it can be manipulated with absolute accuracy by the type of selective breeding used. It can be made to hold off for any number of generations desired, or to appear in the next generation, as in the case of male 14583 with a squamous cell carcinoma of the neck in generation 6, following female 12779 with a squamous cell carcinoma of the neck in generation 5; or male 14631 with pseudoleukemia in generation 6 following female 12779 with pseudoleukemia in generation 5.

If human cancer statistics when correctly taken, were biologically read, they would show as certainly as do mouse statistics the inheritability of cancer. They would show that the human heterozygote carries and transmits neoplastic tendencies, exactly as do mouse heterozygotes, although they themselves do not develop the disease. This follows exactly the classic Mendelian pattern from the mating of pigment-bearing with non pigment-bearing mice.

CHART 16

Chart 16 shows part of Strain 392. The parent, female 26, had a sarcoma of the ovary, sarcoma of the liver, sarcoma of the kidney and perirenal tissues, and a sarcoma of the mesentery. She was mated with male 814, who died of myocarditis. By the right selective mating, the occurrence of sarcoma (and all types of neoplasms) was held off through the three succeeding generations. In the third hybrid generation by the selection of two individuals heterozygous to sarcoma, sarcoma appeared in the immediate offspring (generation 4) female 12058, who repeated the sarcoma of the kidney and of the ovaries of her grandmother four generations back and added also bilateral sarcoma of the uterus. No human hospital statistics could have shown the correct cause of death through four generations. If therefore, this had been a human case, there would have been no record of tumorous ancestry—yet there is here the most evident and perfect persistence and final emergence of the exact type and locations of neoplasms, through the right selective breeding to bring it out.

CHART 17

Again note Chart 17, showing Strain 465 with partial ancestry. Let me go through this chart somewhat in detail, in order that we may see the perfect evidence it affords of (1) the segregating out of tumor types and their consequent inheritability, and (2) the segregating out and consequent inheritability of a specificity of organ tissue type, transmitted through generation after generation both where inbreeding and where hybridization was employed.

Female 3 and male 30 were the ancestors of the paternal side of this strain. Female 3 had a sarcoma-carcinoma of the mammary gland, a malignant adenoma of the liver, and sarcoma metastasis of the kidney. Male 30 was proved heterozygous to tumor. This is a case then of mating a tumorous individual (recessive) with a heterozygote. In accordance with the Mendelian expectation from such a cross, tumor comes out in the first hybrid generation, namely female 883 with an adenoma of the liver.

In the first filial generation, this female 883 with an adenoma of the liver, was *hybridized* with male 842, who died of uncertain causes, but who was proved heterozygous to tumor. Their son, male 1101 dying from acute nephritis, was heterozygous to liver tumor. He was *hybridized* with female 441 (entirely unrelated) who was also heterozygous to tumor. Their son, male 3024, was *hybridized* with female 3920, who came of a liver tumor ancestry and who herself had an adenoma of the liver. Note the outcropping of liver tumor in the second hybrid generation, female 5305 with a sarcoma of the liver. Note here how there segregated out on the one hand the unit character sarcoma introduced by female 3, five generations back, and on the other hand the specificity of liver tissue type locating tumors in the liver, which also was originally introduced by female 3, transmitted through and reinforced by female 883 and female 3920. Note how in this generation the unit character sarcoma got into combination with liver tissue of a type to yield to neoplastic growth (another unit character), so that we have in female 5305 a *sarcoma of the liver.*

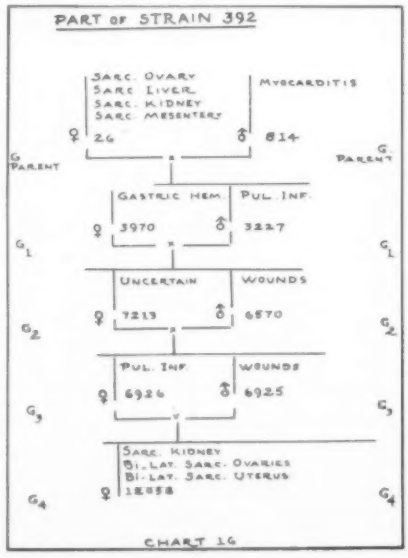


CHART 16

This female 5305 was *hybridized* with male 5215, who died of chronic nephritis. Through three succeeding generations, by the right selective matings, all occurrence of neoplasm was held off. But the certainty of its transmission by heredity is indisputably demonstrated, for, by the use of analyzed individuals, two mice heterozygous to liver tumor were selected in the third filial generation, namely female 9847, who died of chronic nephritis, and male 8852, who died of a lung abscess, so that liver tumor appeared in the next generation. Not only liver tumor occurred, but the same combination of unit characters occurred, namely, the combination of sarcoma, and the neoplastic tendency in the liver.

Let me summarize the facts demonstrated in this chart (Chart 17).

(1) Sarcoma segregated out and was transmitted as such.

(2) Adenoma segregated out and was transmitted as such.

(3) Other types of neoplasms segregated out and were not transmitted at all in this line of succession.

(4) A specific type of liver tissue (viz. lacking the non-cancer mechanism) segregated out and was transmitted as such, so that five liver tumors occurred in this small family alone.

(5) A specific type of tissue in all other organs (viz. possessing the non-cancer mechanism) segregated out and was transmitted as such, so that all other organs refused neoplastic growth, with the single exception of female 11252, whose liver sarcoma spread by extension into the common bile duct, and who had also a lymphosarcoma of the stomach; but it is notable that this is the family in which nearly all of the few stomach tumors in this stock have occurred.

In the light of such perfect evidence as this, it is logically absurd to question the segregating out as unit characters of the sarcoma tendency, the carcinoma tendency, the adenoma tendency, and the tendency to a specific type of organ tissue determining the location of neoplasams, and their transmission as such by heredity. Moreover, when we have such analyzed human individuals and such exact data concerning their neo-

plasms (if such a time ever comes) we shall find that exactly the same laws govern the transmission and occurrence of human neoplasms, otherwise there is no such thing as biologic or organic law.

Charts 11 to 17, inclusive, show how the tendency to neoplasms of specific types and of specific organs is carried along by heterozygotes, and how by the right selective matings alone, both in inbreeding and in hybridization neoplasms of these types and of these organs can be held off or brought out at will in the resulting strains by the use of analyzed individuals. Such neoplastic tendencies can be carried along by heterozygous individuals through any number of generations desired, just as the tendency to albinism can be carried along by heterozygotes as long as may be desired. But by the right selective breeding, both the neoplastic tendency and the albinic tendency can be made to emerge at will.

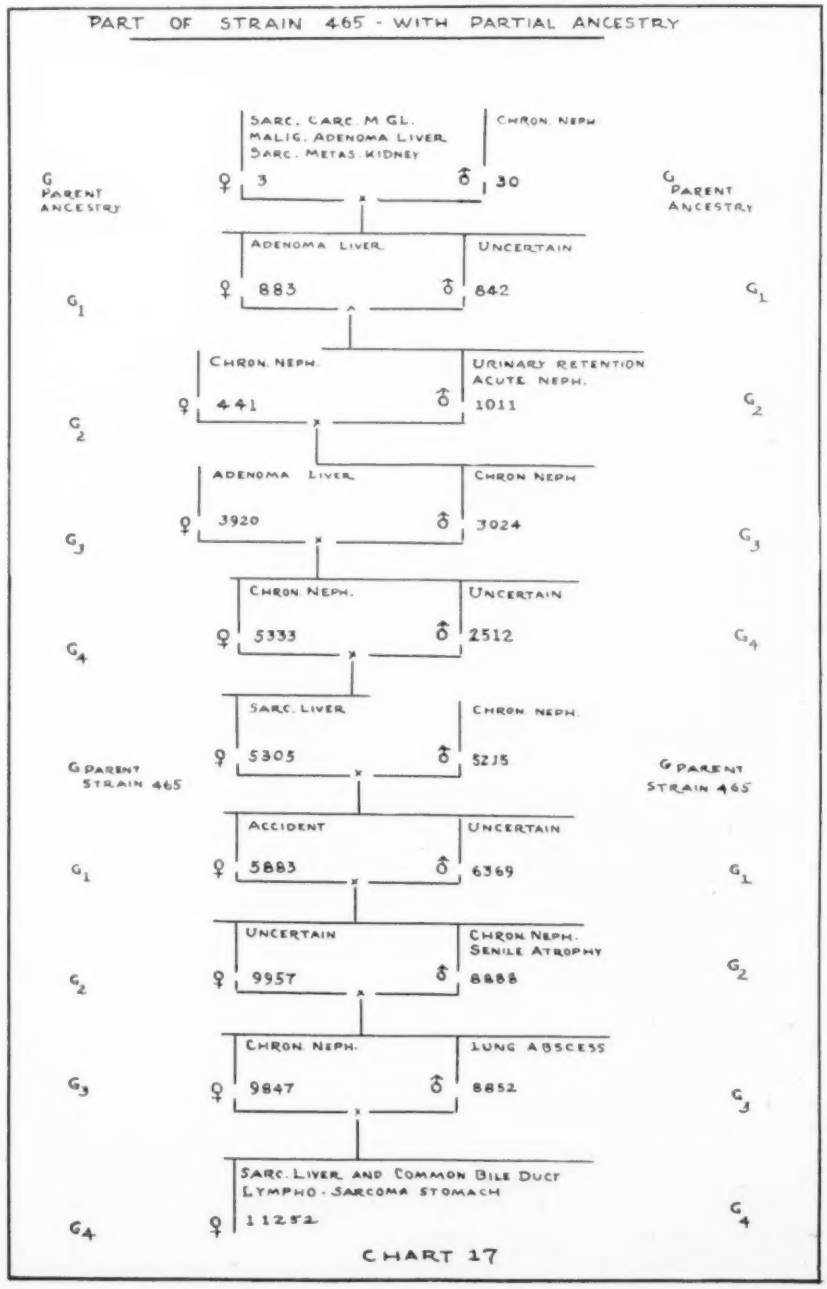
The heterozygote, then, the product of hybridization in any species or any variety, in whom the recessive (cancer or albinism) lies hidden but potent for transmission, may be a very puzzling factor in heredity; for he contains in his germ plasm and therefore can transmit to his offspring, unit characters different and frequently opposite in nature. As, for example, a pair of heterozygous black mice transmitting albinism to their immediate offspring, or a pair of heterozygous non-cancer mice transmitting cancer to their immediate offspring, because potential cancer went into the germ plasm from which the heterozygotes developed. The heterozygotes in the human cancer problem have been the individuals who have blinded the readers of human statistics to the fact of the inheritability of human cancer, hiding as they do the recessive (cancer) behind the dominant appearance, which is appearance only.

There is a very widespread objection in the medical profession today to the thought that cancer is inheritable, and a very widespread and ready categorical denial of its inheritability, on the basis of these erroneous and misread cancer statistics. As the opinion of many physicians and surgeons in this matter is based upon the statements made by the Society for the Control of Cancer, let me here quote from this year's annual leaflet put out by the society, item No. 6: "Cancer is not inherited. It is not certain even that a tendency to the disease is inherited."

Let us subject this excerpt to the biologic test. I have reminded you that man repeats in his embryonal development the history of organic evolution. He begins as a single cell. In this cell there is no nose, no legs, no vertebrae arranged in a perfect and beautiful spinal column, no liver, no epithelium, no cancer. What resides in this single cell is tendency to all these things. That is the basis of all heredity. All inherited characters are inherited tendencies of the cell. There is no other form of inheritance.

I have emphasized the evolutionary basis of the law of heredity, a common law of protoplasmic behavior—what goes into the germ plasm comes out in the offspring; the fundamental necessity of similar tissues behaving in similar fashion if there is to be such a thing as species or race. The mouse tumors under study in this laboratory are spontaneous tumors, arising in the natural life of the animal without artificial interference of any sort except that of selective breeding, exactly as man's tumors arise. They arise in the same tissues and in the same organs as the tumors of man; they follow the same clinical course; they cause death in the same ways. Under the microscope they present the same appearance as similar tumors in similar organs in man. *They are the same biologic entity as similar tumors in similar organs in man. And consequently, if we do not discard the theory of evolution, we must admit that they behave in the same way in the matter of heredity as in all other matters.*

When we have found, as we have found in this laboratory for twelve years, that carcinoma and non-carcinoma tendencies segregate out and are transmitted as such; that sarcoma and non-sarcoma tendencies segregate out and are transmitted as such; that a



specificity of tissue type in specific organs segregates out and is transmitted as such so that an organ either has or lacks the non-cancer mechanism; when I say, we have found that these unit characters segregate out and are transmitted as such in mice, so that we can analyze individuals and manipulate these unit characters in heredity as you can pour HCL on Zn with a known outcome—unless we discard the entire biologic science of today, we must admit that these same unit characters segregate out and are transmitted as such in man.

Moreover, the human statistical evidence admitted by the most vigorous opponent of cancer heredity, itself demonstrates the inheritability of cancer in man, when it is correctly and biologically read.

Summary

(1) Cancer and non-cancer tendencies segregate out and are transmitted as such.

(2) They are, therefore, unit characters.

(2) A specificity of tissue type in specific organs from ancestor to offspring segregates out and is transmitted as such.

(4) It is therefore a unit character.

(5) Since these things are unit characters, it is possible to manipulate them by selective breeding and thereby to implant them indelibly in any species, or to *eliminate them permanently and completely from any species.*

(6) Cancer and non-cancer behave as though there were respectively absent or present a mechanism fitted to control proliferation and differentiation in regenerative processes, and an animal either has this mechanism or lacks it, no matter to what species he may belong.

(7) There is, therefore, a ready and certain genetic method of escape from cancer for the individual and for the race.

(8) The demonstration of the inheritability of cancer and non-cancer tendencies in mice is a demonstration of the inheritability of these tendencies in man and in all other species which show cancer, if we are to maintain the theory of evolution and to admit that there is such a thing as biologic law.

(9) The study of cancer behavior, which has demonstrated itself to be fundamentally a biologic problem, makes evident the necessity of understanding and considering the biologic facts underlying all pathologic conditions.

(10) And, therefore, when we shall have gotten biology under all our pathology and bacteriology, all our physiology and therapy, there will no longer be these monstrous diseases, but only the slow and natural death which is the fatigue and diminution and final cessation of the organ and the organism.

(11) From the procedure of analyzing stock into its unit characters in order to manipulate the cancer tendency, there has emerged the fundamental law of heredity—what goes into the germ plasm must come out in the offspring.

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Oxycephaly---Steeple or Tower Head; Turmschaedel; Spitzkopf; Turricephaly; Acrocephaly; Hypsicephaly*

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VON GRAEFE, in 1866, Michel, in 1873, and von Hirschberg, in 1883, were the first definitely to recognize and describe the association of deformity of the head with impairment of vision. Since that time many references to this interesting condition have appeared in the literature. Authors have divided the disease into two types; in one type there is no prominence or protrusion of the anterior fontanel and the condition is named turmschaedel; in the other type there are prominences and protrusions at the anterior fontanels; this condition is named oxycephaly. Oxycephaly has three cardinal features: (1) gradually progressing impairment of vision, (2) exophthalmos, and (3) characteristic cranial deformity. The cause is given as a premature synostosis, usually in the sagittal suture, next in the coronary, temporosphenoidal or parietosphenoidal, and less often in the lambdoidal and parieto-occipital sutures.

Many hypotheses have been advanced as to the cause of the synostosis. Bertolotti suggested that rachitic craniotabes and oxycephaly belong to the same process and only after the synostosis of the sutures of the skull does the picture change and oxycephaly become manifest. Eighty-five per cent of his cases showed skeletal evidences of rickets. Meltzer had much the same experience, but in many cases reported there has been no evidence of associated rickets. Dock has remarked the paucity of information regarding syphilis in the histories of cases quoted to date. There is little evidence to show that meningitis causes irritation of the sutures, indeed the absence of associated mental defects is a contraindication. A congested condition of the contents of the skull giving rise to irritation has been advanced by Virchow. Fletcher has suggested developmental disturbance showing only in the skull. New bone formation has been suggested by Watts, who found ossification over the protruding membrane of the brain in one of his cases two years after a decompression. Pituitary disturbances have been suggested by Fletcher, who pointed out changes in the sella turcica. Hydrocephaly has been ruled out by comparison of the roentgenograms in these two conditions showing nothing in common. Gudden's experiments showed that ligation of the carotid artery caused deformity of the skull without synostosis, while ligation of the jugular vein caused synostosis of the sutures without deformity of the skull. Bertolotti looks on oxycephaly as a lymphatic polyglandular dystrophy. Heredity is not considered a factor.

*—Received for publication April 15, 1922.

Clinical Findings

Fletcher has described three distinct groups: (1) congenital, with the exophthalmos and cranial deformity present at birth, (2) change in the shape of the head developing in the first few months of life, and (3) a condition in which the patient is normal for the first few years, and the earliest signs appear between the second and the sixth years. In the collected cases in the literature the incidence has been largely in the male. In the four cases in the Mayo Clinic series it happens to be divided equally.

The symptom that brings the patient under medical attention is commonly impairment of vision. This may be present at birth, but is usually noted between the second and the sixth years. It may stop at certain degrees or go on to complete blindness. The blindness is due to a postneuritic atrophy. There are various theories with regard to the cause of the optic atrophy. Internal hydrocephalus has been seen, sometimes in three or four ventricles, and bone distortion, or even bone destruction, with alteration of the relations of the nerves and arteries. The arrest of the circulation of the fluids in the sheath and trunk of the optic nerves, has been accepted as the most probable cause. Schloffer devised an operation to attempt to overcome this. The choked disc preceding the atrophy is probably due to intracranial pressure. Anomalies and loss of taste and smell occur as a result of local alterations at the base. Exophthalmos, owing to shortening of the orbital cavities by the pushing forward of the greater wings of the sphenoid to form their posterior in place of their lateral walls, is seen in more than 50 per cent of cases. It is often greater on one side than on the other. The lid symptoms of exophthalmic goiter are not seen. Strabismus, commonly divergent but occasionally convergent, is associated in the majority of cases. Nystagmus is frequent and the mobility of the globes is often limited. Cranial deformity is characteristic, the forehead and anterior portion of the skull being unusually high. The increased height is usually in the frontal region, but it may be in the parietal. A projection corresponds to the sagittal suture and the apex is just posterior to the anterior fontanel. The parietal bones drop abruptly to the normal level and there may be a hollow on each side of the crest. The cranium is always wide in proportion to the length; the cranial cavity may be almost spherical; the vault is pointed; the two halves of the skull are usually symmetrical, but striking exceptions have been reported. Thickening or depressions along the line of the sutures may be seen. Obliteration of the superciliary ridges is often noted. Flattening of the malars, often unilateral, is common. The palate may be shortened and highly arched, cleft palate, anterior and posterior, has been noted, but is infrequent. Prognathism is often seen. The intelligence is unimpaired in oxycephaly, but many patients have an idiotic appearance. Headache, and occasionally convulsions, may occur in the active stages of the disease.

Roentgenographic Findings

The characteristic deformity described under clinical findings is seen in the roentgenogram. The contour of the bone is thinned and over the vault are seen putty-finger impressions due to an atrophy of the inner table and attributed to pressure by the convolutions. The suture lines are usually not seen. There may be an associated hyperostosis, either between the impressions or in other parts of the skull as in the ethmoid or in the sphenoid. The vessel markings are often widened and the vessel foramina enlarged. Areas of spontaneous decompression are sometimes seen, either in the parietal bones, where they may be large and symmetrical, or in the roof of the orbits. The frontal eminences are obliterated in the majority of cases, as are also the frontal and mastoid sinuses. The superior maxillary bones are poorly developed and the shallowness of the orbits is usually apparent. The sella turcica may be exceptionally well delineated; it is often enlarged and displaced backward. The base of the skull shows important changes; the fossae are usually deep and wide, the posterior fossa forming, in some cases, as much as two-thirds of the base. The middle fossa may be deepened, reaching in some

cases a level as low as that of the posterior. The temporal regions are pushed outward so that the temporal fossae may be shallow or obliterated. Bertolotti described a type of *oxycephalic larvee* in which the changes in the skull are not so marked, but those of the orbits and base are diagnostic.

Reports of Cases

Case 1 (A174495). A girl, aged eleven years, was brought to the Clinic because of abnormal development of the head, first noticed at the age of four. Birth delivery had been normal, she had walked and talked at the normal periods, and to all appearances had been a healthy baby. She had had frontal headaches "all her life," coming on after exertion and lasting for an hour or two. She had attended school since her sixth year and had made good progress. One brother and two sisters were living and normal.

Examination showed the biparietal diameter of the head to be greatly reduced with the frontal suture forming a sharp ridge and the height of the elevation at the site of the anterior fontanel. The palate was high and arched. The lower jaw was prognathic. The breast was markedly "pigeon" with Harrison's groove, the pelvis was narrow and funnel shaped; there was some scoliosis in the dorsal spine. The optic discs were reported pale, but within normal limits. The Wassermann test was negative.

The only available roentgenograms unfortunately cut off the vertex in the lateral view, but in the anteroposterior view the characteristic deformity was well shown (Figs. 1 and 2). The putty finger impressions were striking. The lateral sinus was greatly widened. The superciliary ridges were fairly well maintained, but the depth of the orbits was lessened. There was no marked alteration of the sella or of the fossae of the base. The mastoid and frontal sinuses were not seen and the antra of Highmore were small and indistinct. The temporal fossae were obliterated and there was an apparent lack of development of the superior maxillary bones. The lower jaw was projected beyond the line of the upper.

Case 2 (A259660). A boy, aged 5 years, was brought to the clinic because of a deformed head. The deformity had been present since birth. He was a first child, and delivery had been normal. He had always been bright mentally and active in play. Nine months previously he had fallen from a chair and afterwards a small mass eight millimeters in diameter had been noticed in the left frontal region. This gradually increased in size. He had also had intermittent attacks of headache.

Examination revealed a large soft mass, 18 by 14 by 7 cm., in the left parietal region, covered with hair. The right temporal region protruded. There was bilateral exophthalmos, the right more prominent than the left, and nystagmus with divergent squint. The nerve heads were pearly white, the disc margins blurred, but without swelling. The Wassermann test was negative. There were four other children in the family, all normal. A diagnosis was made of incomplete optic atrophy.

The roentgenogram showed the characteristic deformity of the head (Fig. 3). The putty finger impressions were limited to the frontal and anterior superior parietal regions. The frontal eminences were obliterated and there was no evidence of the frontal or mastoid sinuses. The superior maxillary bones were poorly developed. The base of the skull showed marked alteration, the posterior fossa was large and occupied the greater proportion of the basal area; the middle fossa was deepened and the sella was altered and difficult to identify. In the anterior portion of the middle fossa was a depression simulating the sella. The lateral sinus was two centimeters in width. The sphenoid bone was deformed lessening the depth of the orbital cavities. A large shadow overlying the parietal area suggested hernia of the cerebrum. The origin of this hernia could be traced to the posterior portion of the parietal bone where an area was seen that strongly suggested spontaneous decompression. The absence of putty finger impressions in the posterior two-thirds of the cranial vault rather corroborated the presumption of spontaneous decompression associated with the hernia. Over the latter half of the shadow could be traced a series of branching lines continuous with the bone; these were interpreted as commencing ossification over the protruding mass similar to the ossification noted by Watts in his case.

Case 3 (A369905). A girl, aged two and one-half years, whose head had been deformed since birth, was

Fig. 1—Case 1 (A174495)—Lateral view. Putty finger impressions of intracranial pressure. Prominent lateral sinus. Little evidence of mastoid cells. Lower jaw projected (prognathism). Sella apparently normal in size and position with depth of the orbits lessened.

Fig. 2—Case 1 (A174495)—Anteroposterior view. Central ridge and bulging in the temporal region. No evidence of the frontal sinuses.

brought to the Clinic for consultation with regard to a cleft palate. The child had sat up at the age of six months; she had not walked but stood firmly and could climb well. She could say only a few words. Two brothers and two sisters were normal.

Examination revealed a cleft soft palate, widely separated peg shaped teeth and ptosis of both eyelids, but no exophthalmos. There was a hemangioma over the forehead about five centimeters in diameter. The optic nerves were pale, grayish, and blurred.

It was difficult to secure roentgenograms, and only one was suitable for reproduction (Fig. 4). The putty finger impressions were evident over the entire cranial vault. The base showed marked alteration, the posterior fossa occupying a major portion of the basal area, and the middle fossa was deepened almost to the level of the posterior.

Case 4 (A380861). A boy, aged five years, was brought to the Clinic because of a prominent forehead and exophthalmos, both of which had been present since birth. When he commenced to walk it was noticed that he was partially blind. He was the fourth child, and, while labor had been difficult, instruments had not been used. He had been breast fed, and, except for slight difficulty in breathing, he had developed normally. Three sisters and two brothers were normal. One uncle was known to have prominent eyes and strabismus.

Examination revealed the high forehead and characteristic ridge and protrusion at the site of the anterior fontanel. The profile of the face was flat. The teeth were irregular and prognathism was marked. A Harrison's groove was detected at the lower end of the sternum. There was hypermotility of the hip and ankle joints. Vision was very poor. Bilateral simple optic atrophy, with divergent strabismus and nystagmus were present. The palate was high and arched.

Roentgenograms revealed the characteristic cranial deformity and the putty finger impressions (Figs. 5 and 6). The superciliary ridges were obliterated; there was no evidence of the frontal or the mastoid sinuses. The base of the skull was not markedly altered and the sella turcica appeared normal in size and contour. The temporal fossae were obliterated, bulging being quite marked in that region. Prognathism was striking.

Prognosis and Treatment

Unless the patient is seen early, irreparable damage will be done to the optic nerves. Various decompression operations, such as lumbar puncture, subtemporal (unilateral or bilateral) trepanation, ventricular puncture, and puncture of the corpus callosum have been done and at least temporary improvement has resulted. After blindness has occurred, operation cannot restore vision but may be useful for the relief of pain or other pressure symptoms. With advanced optic atrophy and no other pressure symptoms operation is not indicated, though Watts had encouraging results in such types of cases. Results from the canal operation of Schloffer in the hands of some operators have been encouraging. Briefly, if the patient is seen early there is hope of limiting the impairment of vision. Later, treatment is indicated only for pain or pressure symptoms.

Note—A number of important articles on the subject, not referred to in the text, are included in the bibliography.

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Fig. 3—Case 2 (A259660)—Lateral view. Characteristics of oxycephaly with large mass projecting from vertex. The bony strands over the posterior portion of the mass are continuous with the bone of the skull. Ossification in the lining membrane of the herniated mass is suggested.

Fig. 4—Case 3 (A369905)—Lateral view. Characteristic deformity of the head and the putty finger impressions. Head somewhat angled and relations distorted. Apparent deepening of the middle cranial fossa so that it is almost on a level with the posterior.

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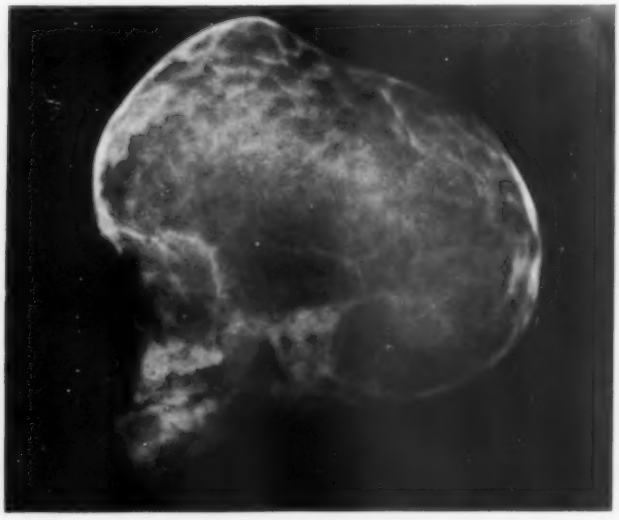

Fig. 5—Case 4 (A380861)—Summit of the projection at the site of the anterior fontanel and the abrupt decline just posteriorly. The superior maxillary bones and the prognathic lower jaw apparently are underdeveloped. The sella turcica and fossae of the base appear normal.

Fig. 6—Case 4 (A380861)—Anteroposterior view, showing the characteristic central ridge bulging in the temporal regions and absence of the frontal sinuses.

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Effect of Heavy Radiation on the Pleurae and Lungs*

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THE STUDY of the effect of radiation on the pleurae and lungs is becoming more and more imporant with the increasing use of radiation in the treatment of cancers of the breast. It is even more important in cases referred for treatment following surgical removal of cancer of the breast. It is more important in this tvpe because any untoward action on the pleurae and lungs cannot be excused on the ground that the severity of the lesion demanded the treatment no matter what the after effects might be.

A careful search of medical literature has failed to find any article calling the matter to our attention. In fact, it has been only a few years since Dr. George E. Pfahler denied that x-radiation produced deleterious effects on the pleurae and lungs, saying that his experience had proved that all cases showing changes in the pleurae and lungs proved to be malignant metastases. We had held the same opinion until the past year. In a paper read by Dr. Russell D. Carman at the Boston meeting of the Radiological Society of North America in June, 1921, he discussed the roentgenological appearance of malignancy metastatic in the lung. He made the statement that malignancy never spread from the hilum outward. In the discussion he said pathologists informed him that malignancy never took this form.

A review of our cases showed greater frequency of this complication since the advent of heavier doses of more highly penetrating x-rays. We found that only three cases who had suffered from this complication had demonstrable metastases in the pleurae or lungs at the time when they first came for treatment. All of the cases here discussed are those sent for postoperative irradiation for prophylactic purposes. Those suffering from demonstrable malignancy of the lungs or pleura have been purposely omitted.

Physical Examination of the Chest

While the number of cases under consideration in this series is small, it has seemed to us that a report of the findings on physical examination of the chests of patients subjected to heavy radiation of the pleurae and lungs might not prove without interest.

The production of fibrous tissue in muscle which has been repeatedly exposed to the action of radiation is well known, and suggests that the same or a similar change may take place in the pleurae and lungs of patients treated for carcinoma of the breast by radiation when this is sufficiently prolonged or of sufficient intensity.

Believing that when structural changes in the lung and pleura have occurred, so pronounced as to be demonstrable radiographically, there should be changes from the normal physical signs, we undertook a careful study by physical examination of the cases reported. None of the cases studied, either on admission or during treatment, presented chest metastases.

The first change detected by us was manifested in the breath sounds, which became harsh and of a blowing character over the areas involved, even before there was any evident impairment of resonance on percussion. Two cases which later returned with pleuritis and effusion, on first examination, in addition to blowing breathing, had slight friction rubs. Harsh breath sounds was an early and constant characteristic in all cases in which there was a fibrotic change in the lung, this increasing in intensity as the process in the lung progressed. The cases in which moderate effusion developed gave the physical signs of fluid only.

When what we have called the terminal stage, as represented by the third radiograph in each series, is reached, physical examination of the chest reveals the findings typical of a pneumonic consolidation. In each instance, physical and radiographic examination of the chests of these cases on admission, before radiation treatment was instituted, failed to disclose any evidence of what we have termed, "fibrosis in the lungs."

General Discussion

The study of this condition is not only of importance from a therapeutic standpoint, but is extremely important from a diagnostic standpoint. We are under the impression that practically all of the men who have been finding these changes in the lung have been making the same interpretation that we did previously to the last year, that is, they have been calling these changes metastases into the lungs and pleurae when in reality they are fibroses produced by radiation.

It will be noted by making a detailed study of the x-ray findings as given under the case reports that a steadily progressive change takes place in the lungs and pleurae following radiation. It is surprising to notice how little radiation produced the change in some of the patients. Seven cases here reported show that the change was recognized in one case after 120 milliampere minutes irradiation over the back of the chest. This dosage was given in two series, each series composed of 60 milliampere minutes dosage. Out of these seven cases the one having the largest dose before changes were recognized, had 540 milliampere minutes over the front of the chest and 190

*—Read at the Midyear Meeting of the Radiological Society of North America, St. Louis, Mo., May 20, 1922.

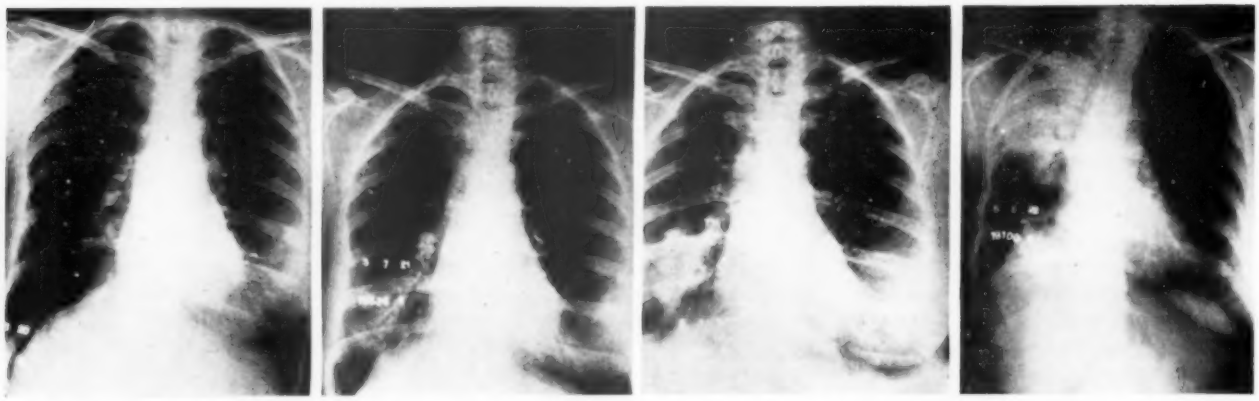

Fig. 1—Case No. 14610—Mrs. J. P. A.—(1) Roentgenogram made at time of patient's admission before treatment was given, showing some increase in the right hilum. (2) First examination, showing increased density in the right lower lobe with limitation of movement of the inner half of the diaphragm. (3) Roentgenogram made approximately two months later, showing marked increase in density in the right lower lobe. (4) One year later than No. 3, showing collapse of the lower part of the right lung and marked increase in density above the site of the collapse.

milliampere minutes over the back of the chest. The average for the seven is 257 milliampere minutes in front and 190 milliampere minutes on the back. From these figures it will be seen that the dosage which was given was really not as much as we frequently use in treating malignancy. We cannot explain why some patients develop these changes so much more quickly than others and under so much less dosage. It would seem reasonable to believe, however, that patients who develop this condition after radiation may have had some other disease of the lung which has become arrested and has sprung up following the radiation reaction.

We regret that at this time we are unable to report necropsy findings in any of these cases. We have had two deaths which are not reported in this series, both of them having definite metastases in the lung. There has been only one death in cases where metastases were not demonstrable. Some of the cases are living for a considerable period of time since the changes in the lung were first recognized.

Clinical effects of these changes: When the patients develop these changes in the lungs and pleura the first thing to which they call attention is usually a pleuritic pain characterized by stabbing on inspiration. Physical examination at this time will show a friction rub. This goes on for a time when one will be able to recognize radiographically a thickening of the pleura at the site of the pain, together with a beginning change along the bronchi, extending from the hilum out to the periphery at the point where the pleura is thickened. This will naturally have the fan-shaped appearance of the normal anatomical structures of the lung. As the process continues the patient gets sufficient involvement of the lung to interfere with its function. In more advanced cases the patient becomes cyanotic, suffers from dyspnea and cardiac embarrassment. Cardiac embarrassment is more marked where changes have been found in the left side and we think that this is due to the fact that pleuropericardial adhesions form at the same time that adhesions form between the visceral and parietal layers of the pleura. The diaphragmatic pleura also becomes adherent and as the changes advance and the contracting changes take place, the lung is actually pulled inward away from the chest wall at the points where the pleura is not adherent. At the same time the diaphragm is pulled upward and rendered immovable. In cases where the visceral and parietal pleurae have become densely adherent the hilum of the lung will move outward toward the chest wall. This is especially well demonstrated in case number 14655. By careful inspection of the x-ray plates of this patient it will be noticed that the left bronchus is pulled upward and outward so that it shows well beyond the heart and great vessel shadows.

During the earlier part of these changes the patient is considerably embarrassed and not able to go about. After the changes have become more or less well established and the patient has become accustomed to depending upon the opposite lung she is able to get about and to perform her ordinary duties.

In the terminal stages the intercostal muscles become depressed and the intercostal space on the affected side narrowed. At the same time a lateral curvature of the spine occurs, the concavity being toward the affected side. In some cases the muscles of the chest wall become hard, fibrotic and inelastic.

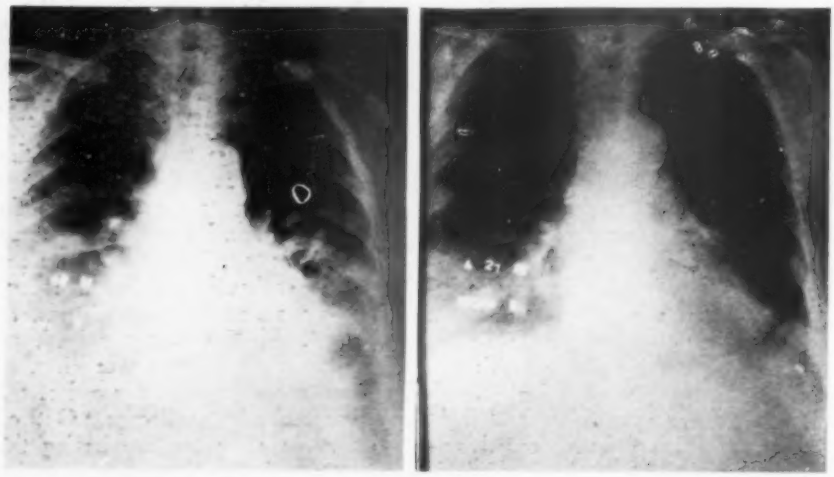

Fig. 2—Case No. 14393—Mrs. E. C.—(1) Roentgenogram made when increase in density in the left lung was first recognized. (2) Same patient after the area of increased density had subsided, leaving only a small area of fibrosis.

Conclusions

From the facts enumerated above it would seem that we are justified in drawing the following conclusions: First, prophylactic irradiation of the chest following surgical removal of the breast should, as a rule, be carried out with what might be called, "superficial technique"; that is, instead of using

the high voltage for this work we should use the low voltage and thin filters. We feel that it is unwise for us to repeat the dosage more than two or three times. Second, it would appear that the high voltage technique should be reserved only for inoperable cases of carcinoma of the breast. Third, we feel that this pathology should be definitely recognized by the medical profession so that these patients will not be mistreated by being given more radiation after these changes are manifest. Knowledge of this pathology will also influence the prognosis in this type of case.

TABLE SHOWING DOSAGE USED IN THE CASES REPORTED

Dose Given Before Change Recognized			Total Dose	
Front Ma. Min.	Series	Back Ma. Min.	Front Ma. Min.	Back Ma. Min.
120	2	120	420	540
360	4	210	540	300
150	2	150	330	300
180	2	210	300	300
180	2	180	330	180
270	3	270	870	882
540	6	190	912	340
Average 257		190	529	406

The following detailed case reports show the changes in the lungs and pleurae from their earliest recognition progressively to the time of the last observation.

Case No. 14610 (Fig. 1)—Mrs. J. F. A. 57 years of age. Admitted October 11, 1920.

Diagnosis: Carcinoma of the right breast.

Her family history is negative.

Her personal history also is negative.

Present Illness: Five years ago the patient noticed a lump in the upper, outer quadrant of the right breast. The right breast was amputated in September, 1919. A recurrence in the scar was removed in September, 1920.

X-ray Fndings: October 11, 1920, there was no evidence of metastases in the lungs. March 7, 1921, a considerable area of fibrosis extended into the right lower lobe. May 1, 1921, the area of infiltration in the right lower lobe extended from the fourth to the seventh ribs anteriorly. September 30, 1921, there was an extensive area of consolidation, probably a fibrosis, in the right lung, extending from the second to the fifth ribs anteriorly, with thickening of the pleura over the right apex. Pleurodiaphragmatic adhesions were found on the right side, but no movement.

Physical Examination: November 14, 1921, there was dullness and bronchial breathing over the middle and right lower lobes, also evidence of consolidation.

X-ray Examination: November 15, 1921, there was an area of increased density under the right scapula from the second to the sixth ribs in the midscapular line. This bulged inward like a localized accumulation of fluid in the pleural sac. There was an area in the right lung central to this. The trachea and all of the mediastinal structures were drawn over to the right. There was thickening of the right pleura over the apex and base.

Physical Examination: January 10, 1922, classical physical signs of consolidation were in the entire upper and middle lobes of the right lung. There was dullness, increased vocal and tactile fremitus, and bronchial breathing.

X-ray Examination: January 10, 1922, the pleura was thickened over the entire right lung. The right middle lobe shows evidence of fibrosis along the bronchi extending out from the hilum in a fan shape. There was a mass projecting inward from the chest wall in the right posterior axillary line extending from the second to the fifth ribs. February 16, 1922, in addition to the above there was marked thickening of the pleura over the right lower lobe. The right diaphragm did not move. There was no evidence of fluid.

X-ray treatment, which was given up to the time the lung changes were demonstrable: 9¾ inch spark gap, 6 millimeters of aluminum and sole leather, 6 milliamperes, 10 inch anode-skin distance through multiple small ports of entry, 120 milliampere minutes posteriorly and 120 milliampere minutes anteriorly. The total dosage was 540 milliampere minutes posteriorly and 420 milliampere minutes anteriorly.

Case No. 14393 (Fig. 2)—Mrs. E. C. 69 years of age. Admitted September 13, 1920.

Diagnosis: Carcinoma of the left breast.

Her family history was negative.

Personal History: About eight years ago the patient developed what she thought was an eczema of the left nipple. Under instructions from a friend, she repeatedly scrubbed this with a stiff tooth brush. The condition gradually grew worse until one year ago, 1919, a bleeding presented itself which has continued to September 13, 1920. Recently the patient noticed shooting pains and found some lumps in her left axilla.

Physical Examination: There was an ulcerating cauliflower growth two and a half centimeters in diameter involving the left nipple area, the nipple having been destroyed. There were palpable left axillary glands. She was referred for surgical removal of the breast.

Microscopical Report: Basel cell carcinoma.

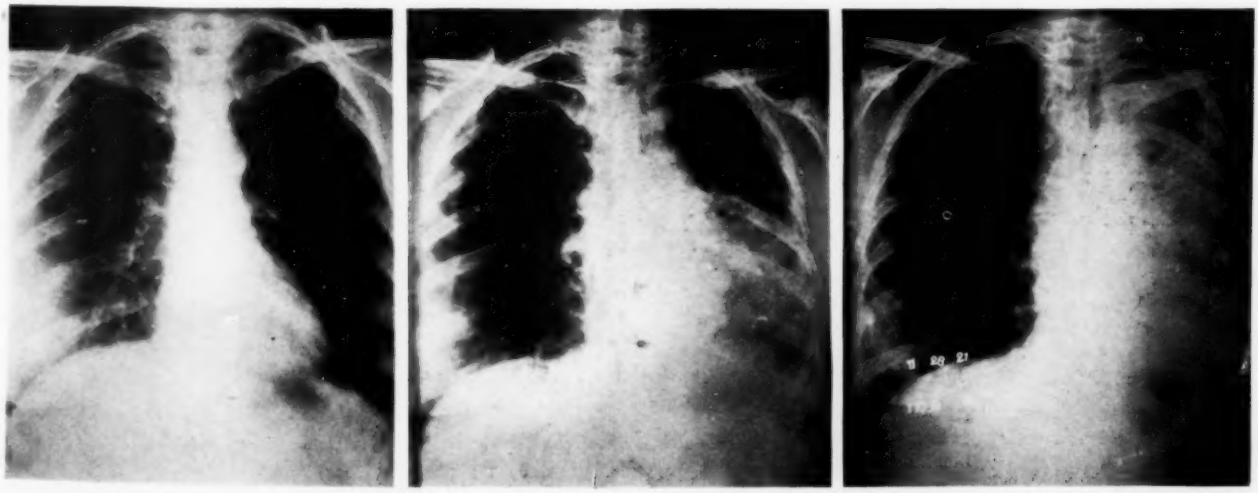

Fig. 3—Case No. 14520—Miss S. P.—(1) Roentgenogram made at time of admission, before treatment was given, showing no increase in density in the left lung. (2) After treatment was given, showing marked increase in density involving the left lower lobe. (3) Same patient still later, showing increase in density throughout the whole left lung.

X-ray Examination: September 13, 1920, there was no demonstrable pathology in the lungs, pleura or ribs. March 22, 1921, an area of infiltration in the left lung extended out from the hilum in fan shape under the third to the fifth anterior ribs. This has the appearance of fibrosis. April 27, 1922, the area of infiltration shown above had disappeared with the exception of a small area in the third interspace.

X-ray treatment which was given up to the time the lung changes were demonstrable: 9¾ inch spark gap, 6 millimeters of aluminum and sole leather, 6 milliamperes, 10 inch anode skin distance, 360 milliampere minutes anteriorly and 210 milliampere minutes posteriorly. The total dosage was 640 milliampere minutes anteriorly and 300 milliampere minutes posteriorly.

Case No. 14520 (Fig. 3)—Miss S. P., 50 years of age. Admitted October 30, 1920.

Diagnosis: Carcinoma of the left breast.

Family History: Her mother died of asthma, her father of tuberculous enteritis.

Personal History: She had had one menstrual period in the year previous. Twenty years before she had had typhoid and also appendicitis.

Present Illness: Radical amputation of the left breast was performed August 24, 1920. Cervical glands were removed one week later. October 16, 1920, she had an attack of severe pain in the left chest, which increased on deep inspiration, accompanied by chills and fever. This cleared up in a few days.

X-ray Examination: December 20, 1920, the lungs, pleurae and ribs were negative for new growth. February 24, 1921, the entire lower lobe of the left lung was infiltrated. The pericardium was adherent to the pleura in the region of the auriculoventricular junction. The whole mediastinum showed infiltration. April 4, 1921, practically the entire left lower lobe was infiltrated. The heart was misplaced so that the right border rested at the left of the spinal column. May 2, 1921, considerable infiltration showed in the right lower lobe. May 15, 1921, as above, the lower lobe of the left lung was involved and there was then some fluid in the left pleural sac. September 1, 1921, the pleura over the entire left chest was greatly thickened. The lower three-fourths of the left lung field was radiopaque. The left diaphragm was fixed. The costophrenic sinus was obliterated. November 26, 1921, there was no fluid demonstrable in the left pleural sac. The pleura was markedly thickened throughout. The lung showed fibrosis extending out from the hilum along the bronchus. The heart and great vessels were drawn over into the chest. There was no movement of the left diaphragm. Air entered the entire left lung.

X-ray treatment which was given up to the time the lung changes were demonstrable: 9¾ inch spark gap, 6 millimeters of aluminum and sole leather, 6 milliamperes, 10 inch anode-skin distance through multiple small ports of entry, 150 milliampere minutes anteriorly. The total dosage was 330 milliampere minutes anteriorly, and 300 milliampere minutes posteriorly.

Case No. 15012 (Fig. 4)—Mrs. E. C., 47 years of age. Admitted December 20, 1920.

Diagnosis: Carcinoma of the right breast.

Her family history was negative.

Her personal history was negative.

Present Illness: A tumor was removed from the outer half of the right breast in 1918. In 1919 there was a recurrence near the scar. On November 16, 1920, a radical removal of the right breast was done.

Microscopical Examination. Adenocarcinoma.

Physical Examination: Negative.

X-ray Examination: December 20, 1920, there were no demonstrable metastases in the lungs, pleurae or ribs. May 26, 1921, there was extensive infiltration in the mediastinum with areas of consolidation in the right lung from the second to the fourth interspace. June 30, 1921, there was still infiltration in the region of the right hilum, but less marked than at the last examination. August 16, 1921, there was an area of consolidation in the central portion of the right lung extending from the second to the fifth ribs anteriorly. There was no movement of the right diaphragm.

X-ray treatment which was given up to the time the lung changes were demonstrable: 9¾ inch spark gap, 6 millimeters of aluminum and sole leather, 6 milliamperes, 10 inch anode-skin distance through multiple small ports of entry, 180 milliampere minutes anteriorly, 210 milliampere minutes posteriorly. The total dosage was 300 milliampere minutes anteriorly and 300 milliampere minutes posteriorly.

Case No. 16291 (Fig. 5)—Mrs. A. B., 47 years of age. Admitted July 9, 1921.

Diagnosis: Carcinoma of both breasts.

Her family history was negative.

Personal History: At 16 years of age she had malaria, tonsillitis and oral infection.

Present Illness: In 1916 the left breast was amputated for carcinoma. A tumor was enucleated from the right breast at the same time. A short time

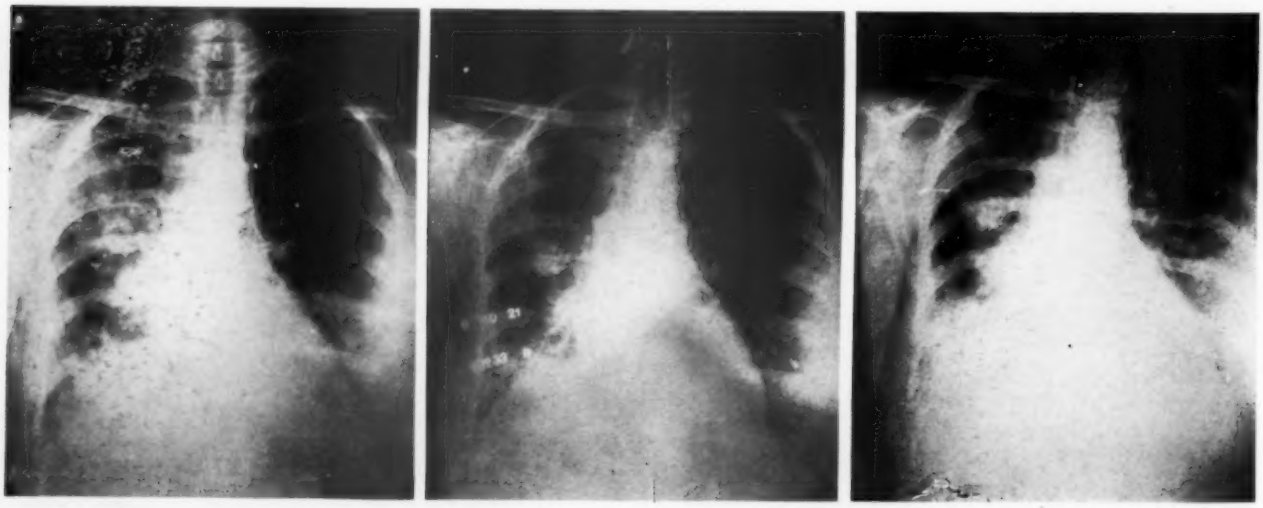

Fig. 4—Case No. 15012—Mrs. E. C.—(1) Showing marked increase in density in the right lung after treatment had been given. (2) Showing diminution of the size of the area of increased density, elevation of the diaphragm and beginning contraction of the lung. (3) Showing marked contraction of the lung and fixation of the right diaphragm. The area of increased density is still present.

ago she noticed a lump in the right axilla.

Physical Examination: There were palpable glands, two and a half centimeters in diameter, in the right axilla.

X-ray Examination: July 9, 1921, there was no demonstrable new growth in the mediastinum, pleurae, ribs or spine. October 20, 1921, the right lobe was filled with many small areas of consolidation. These extended out along the bronchi and gave an appearance similar to influenza pneumonia. There was no movement of the right diaphragm. January 10, 1922, there was marked thickening of the right pleura anteriorly from the third rib down to the diaphragm, and outward to the anterior axillary line. There were several small areas of smoky white appearance which we thought were areas of consolidation. There was partial collapse of the right lung.

X-ray treatment which was given up to the time the lung changes were demonstrable: 9¾ inch spark gap, 6 millimeters of aluminum and sole leather, 6 milliamperes, 10 inch anode-skin distance through multiple small ports of entry, 180 milliampere minutes anteriorly and 190 milliampere minutes posteriorly. The total dosage was 11½ inch spark gap, 1 millimeter of aluminum, ½ millimeter of copper, 6 milliamperes, 14 inch anode-skin distance, 150 milliampere minutes over one area covering the right chest, together with the 180 milliampere minutes anteriorly and 180 milliampere minutes posteriorly with the low voltage technique as described above.

Case No. 15010 (Fig. 6)—Mrs. J. W., 60 years of age. Admitted December 20, 1920.

Diagnosis: Carcinoma of the left breast.

Her family history was negative.

Personal History: She had malaria in childhood, tonsillitis and oral infection.

Present Illness: The left breast was amputated on November 8, 1920. Three weeks later she had two x-ray treatments.

Physical Examination: Negative.

X-ray Examination: December 20, 1920, there was an area of bone destruction (metastasis) three-fourths of an inch long involving the lower half of the anterior portion of the left third rib. April 4, 1921, there was infiltration in the left lung extending outward, upward and forward toward the metastasis in the rib. There was also infiltration outward and downward into the right lower lobe. May 9, 1921, there was an area of infiltration in the left lung under the third rib, which appeared less dense than at previous examination. June 21, 1921, there was still an area of infiltration in the left lung under the third rib and quite an extensive area of infiltration extending outward and downward in the left lower lobe. August 2, 1921, the infiltration in the left lung was considerably increased. The diaphragm was fixed and there were adhesions between the pleura and the pericardium. November 1, 1921, marked fibrosis extended out from the mediastinum into the left lower lobe and also into the left upper lobe under the left third rib anterior. The pleura was markedly thickened over the left base. December 14, 1921, there was thickening of the pleura over the left base, and infiltration out from the hilum with fibrosis in the lung under the left second rib anterior. January 20, 1922, the right lung was clear. The left lung showed marked thickening of the interlobar pleura, also the pleura over the left base. March 15, 1922, the major portion of the left lung field was occupied by what appeared to be thickened pleura, having the same shape as that found in pleural effusion. The left upper lobe was clear.

X-ray treatment which was given up to the time the lung changes were demonstrable: 9¾ inch spark gap, 6 millimeters of aluminum and sole leather, 6 milliamperes, 10 inch anode-skin distance through multiple small ports of entry, 270 milliampere minutes anteriorly, and 270 milliampere minutes posteriorly. The total dosage was 11½ inches spark gap, 1 millimeter of aluminum and ½ millimeter of copper, 6 milliamperes, 14 inch anode-skin distance, one large port of entry covering the front, one large port of entry covering the back, 300 milliampere minutes anteriorly, and 300 milliampere minutes posteriorly, together with 570 milliampere minutes anteriorly and the 582 milliampere minutes posteriorly given with the low voltage technique described above.

Case No. 14655 (Fig. 7)—Mrs. S. M. W., 69 years of age. Admitted October 18, 1920.

Diagnosis: Carcinoma of the left lobe of the thyroid.

Her family history was negative.

Personal History: She was operated upon in 1910 following trauma of the right tibia. At 35 years of age she had a double o-ophorectomy performed.

Present Illness: June, 1919, she noticed a swelling in the left side of the neck in the region of the thyroid. It gradually grew until in October, 1920, it was the size of the first. Then pain developed behind the left ear and along the ulnar side of the left hand, involving the ring and little fingers.

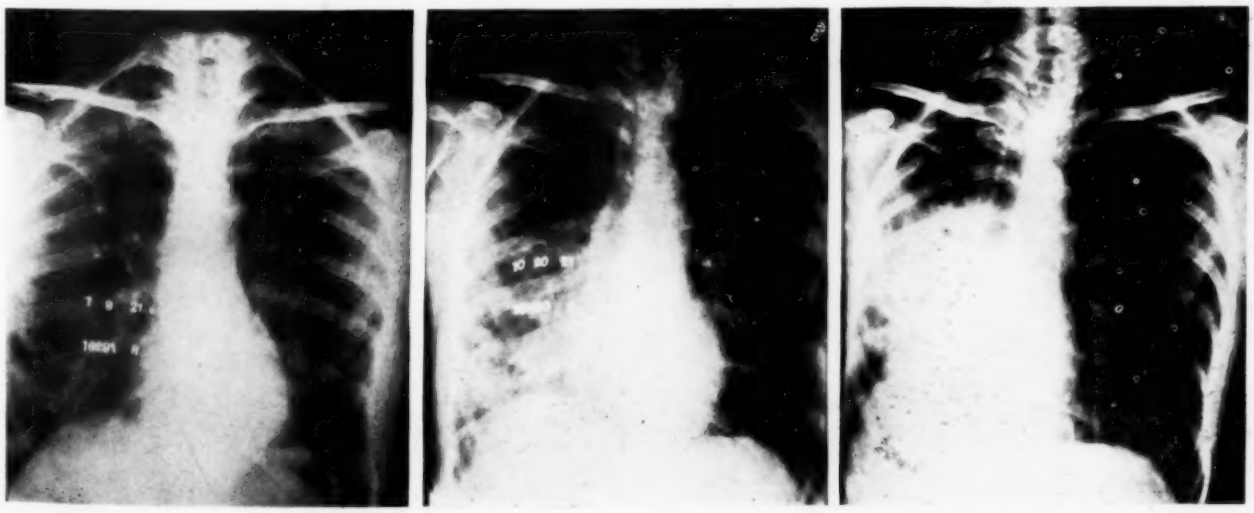

Fig. 5—Case No. 16291—Mrs. A. B.—(1) Roentgenogram made of the chest before treatment was given, showing some infiltration along the bronchi in the right lung. (2) Three months later, showing increased density of the lower half of the right lung. (3) Still later, showing contraction of the right lung and increase in density in the lower half.

Physical Examination: There was a boardlike mass in the left side of the neck in the thyroid region, extending down to the left clavicle and below and behind it. There was hyperesthesia involving the left ring and little fingers. No demonstrable metastases were found in the lungs.

X-ray Examination: October 18, 1920, there was no demonstrable pathology in the lungs, pleurae or ribs. June 14, 1921, extensive infiltration extended from the mediastinum outward into the left upper lobe. There was considerable thickening of the pleura in the left upper lobe. September 27, 1921, the pleura was thickened over the entire upper left lobe. Infiltration from the left hilum to the periphery was more dense than at the last examination. November 23, 1921, massive fibrosis involved the upper lobe of the left lung. The trachea was drawn slightly over to the left. February 21, 1922, there was no demonstrable new growth in the bones. There was still fibrosis involving the left upper lobe, with retraction, and no movement of the left diaphragm.

X-ray treatment which was given up to the time the lung changes were demonstrable: 9¾ inch spark gap, 6 millimeters of aluminum and sole leather, 6 milliamperes, 10 inch anode-skin distance through multiple small ports of entry, 540 milliampere minutes anteriorly, and 190 milliampere minutes posteriorly. The total dosage was 912 milliampere minutes anteriorly and 340 milliampere minutes posteriorly.

Discussion

Dr. George E. Pfahler, *Philadelphia:* I appreciate the paper of Dr. Tyler, but I think we must be careful about drawing conclusions. He has had no autopsies and I think we all saw as the pictures were thrown on the screen that the chest plates at the beginning of treatment, which he called normal, had the beginning of the lesions when he started the treatment. We probably have been wrong in calling that malignant. I am willing to concede that, but it has not been proven, and that the process is there before we start treatment there can be no doubt. I am studying and have studied this and am thoroughly convinced. Every patient who comes in for treatment of carcinoma of the breast gets a film before we start and there are repeated films for months and years afterward, and in all those cases in which these fibrotic processes have developed I have been able to take these plates and trace them right back to the first day, and show that they had begun before the patient came to the office and before they had any treatment.

I think there are two possibilities: First, that we may have a malignant process that is changed into fibrotic tissue; second, that we have a fibrotic process and for some reason the rays stimulate that process. I do not know which of these is correct, but that the condition is there before beginning treatment there is no question and I think we must be careful about taking on to ourselves the blame for producing this and scaring patients away, or scaring patients about the pre-operative or post-operative treatment. Let us investigate this, but let us be careful about drawing conclusions.

Dr. Thomas A. Groover, *Washington, D. C.:* This is a subject in which we have been considerably interested for something more than a year and a half, and one to which we called attention before the radiological section of the Southern Medical Association last November.

Our observations coincide in a general way with those reported by Dr. Tyler and we are rather convinced that the x-ray either causes these changes in the lungs or else has something to do with the development and spread of metastatic foci therein. These changes begin, as a rule, at about the time of the occurrence of the skin reaction. The patient will develop an irritative, unproductive cough about ten days after treatment, and if you will examine the chest at about that time you will see an infiltration beginning, as a rule at or near the hilus, which may spread quite rapidly and in the course of a few weeks involve practically the entire lung. The roentgen picture is not unlike that we sometimes see in influenzal pneumonia. In other instances pleural changes appear to predominate. If these are due to metastatic malignancy, they seem to pursue an entirely different course from that observed in untreated cases. We have cases in which the most critical study fails to show any pathology in the chest antedating treatment.

It is not unreasonable to believe that some change would occur in the lung as a result of intensive roentgen treatment. You may have noticed that in treating lesions about the face the reaction is sometimes more marked on the mucous membrane of the mouth than on the skin. The mucous membrane becomes of a whitish color and has much the appearance of a carbolic acid burn. It is not unreasonable to suppose that similar changes may occur in the pleura or in the lung itself.

In a recent case where we gave a massive dose over the face for malignant disease of the antrum the entire

Fig. 6—Case No. 15010—Mrs. J. W.—(1) Roentgenogram made at time of admission, showing no increase in density in the left lung. (2) Showing beginning increase in density in the central portion of the left lung and in the base, with pericardial thickening and fixation. (3) Increased density involving practically the whole of the left lung.

mucous membrane of the mouth and pharynx showed a marked reaction. This reaction was even more intense on the mucous membrane than on the skin. We believe that the x-ray may produce definite changes in the lung. Certainly the changes Dr. Tyler has referred to seem to be definitely related to the treatment, at least in certain cases, independent of a pre-existing cancer focus. Whether the x-ray causes them is a problem that remains to be solved.

DR. JAMES T. CASE, *Battle Creek, Michigan:* It was my intention to communicate to this society last December some of our observations on this point, but I was so unfortunate as to have to undergo an emergency operation and was unable to attend the meeting. I, with my associate, Dr. Pritchard, have been very much interested in some of these lung changes. We have no postmortem records to show you, but we have seen many changes such as have been referred to by Dr. Tyler and Dr. Groover. I have had the privilege of going over the plates of Dr. Groover's cases, and I have come to the conclusion that all the changes demonstrated in the plates of Dr. Tyler can be accounted for by pleural irritation. They are very similar to the changes we see in patients when they first present themselves for x-ray treatment, especially those who have recurrences in the lung. I believe that these changes are for the most part pleural reactions, and I agree with Dr. Tyler in his assumption that some of the changes are of pneumonic nature.

I wish to report that we have been led by our experience to exercise special precautions in all our cases undergoing radiation therapy for disease of the thorax, during the week or so following treatment, to protect them from draughts or chills or any other influence that might bring on pneumonia. We have been struck with the rather large number of patients who have developed pneumonia or a respiratory affection within a week or two following the radiation. We have had three cases that developed influenza within two weeks following radiation. Two of these cases developed in towns where influenza was epidemic, one fatal case in a small village where one in four had influenza. We are all well acquainted with the chronic indurating edema which affects the skin of patients who have been over-radiated, and I believe that the changes which occur in the lung and pleura following radiation are very likely of this edematous type. These changes are of the chronic, indurative type which we see in the skin and they may be also pneumonic.

The curious thing is that we do not find more patients showing the definite x-ray findings following radiation. We have treated many cases, but we have only four, three influenzas and one pneumonia, so far as we know. We have had some trachitis and other signs of upper respiratory affection in a number of our cases.

I think, as Dr. Pfahler has said, we must be careful in drawing conclusions, but that the upper respiratory tract shows changes following radiation I think we must admit and we must protect our patients against it.

DR. TYLER (Closing): Regarding the discussion of Dr. Pfahler, I notice he did not report any postmortem findings, and neither did Dr. Case, and I did not, and that is the characteristic difference between this and malignancy. You get postmortem examinations in malignancy of the lung, but not in this condition. Dr. Pfahler said that these changes show in the chest before treatment. Why do not all of them get it? They do not, there are just certain ones that get it. We have some who develop effusion in the lungs after treatment. Perhaps, as Dr. Case said, this was due to the fact that they caught cold, or had an influenzal infection afterward. This fluid when drained off from the chest is not bloody, as it would be in malignancy, but clear, straw-colored fluid. The fact that we have an opportunity to make postmortem examinations of the hollow viscera gives us an opportunity to find out what happens to the hollow viscera, and I take it that the lung is as sensitive at least as the skin, or probably more sensitive. I presented this paper as a preliminary report, hoping for a lot of discussion, because it is a problem for all of us. I hope to get some postmortems, and then we will have some proof. The explanation, perhaps, might be that we had developed an irritation of the lung and air passages and that following that the patient was subject to influenzal attacks, etc., and that in the healed portions the parenchyma of the lung changes from its normal air-filled type to fibrous tissue. You can demonstrate this on the x-ray plate and by physical examination. Every patient reported here has had repeated physical and x-ray examination, with stereoscopic pictures and all the careful study any man gives, but we have not yet solved the problem to our satisfaction. We hope some of you will.

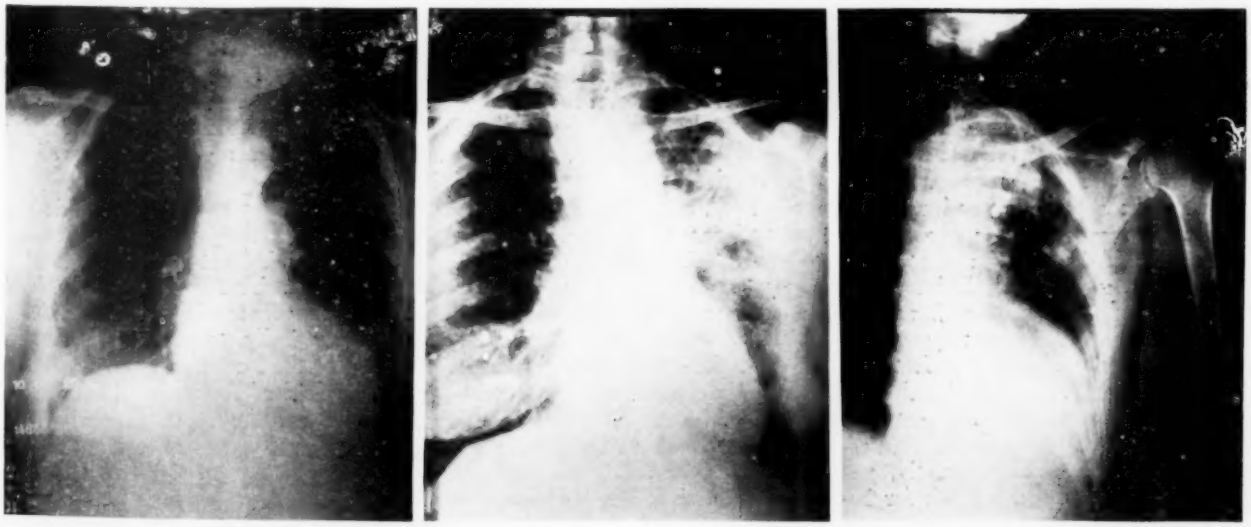

Fig. 7—Case No. 14655—Mrs. S. M. W.—(1) Roentgenogram made at the time of admission, showing no change in the upper half of the left lung. Increased density at the extreme upper portion of the illustration is due to a malignant tumor of the left lobe of the thyroid. (2) Marked increase in density in the upper half of the left lung. (3) Still more marked increase in density of the upper portion of the left lung, with retraction of the trachea toward the left and elevation of the main bronchus. The heart shadow is now entirely to the left of the midline.

Does Radiation Enhance Postoperative Recurrence of Carcinoma of the Breast*

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New York City, N. Y.

CARCINOMA of the breast exacts each year a toll of about 50 per cent of the individuals thus afflicted, and since these cases are numbered by the thousands, it is of intense interest to consider conditions which have an important bearing upon improving these unfortunate end-results. Up to the present there are but two concurrent methods of dealing with carcinoma of the breast, surgery and radiotherapy. It is unquestionably true that surgery deals effectively with some cases, it is equally true that radium and x-ray radiation bring about the clinical arrest of the disease in others. Is it too much to expect, therefore, that perhaps an intelligent combination of the two may not exert a better influence upon the ultimate outcome of these cases?

You will permit me, perhaps, to digress for a moment in order to lead up to the point in question. From time to time one hears statements and reports, such, for instance, as those of Perthes and Tichy, and others who speak from insufficient exeperience and incomplete data, that the incidence of postoperative recurrence following radical excision of carcinoma of the breast is considerably increased by prophylactic radiation. In view of the importance that may be attached to this very question, it seems to me that a careful analysis and study of this subject is warranted. If postoperative radiation be attended by such hazardous risks, as is claimed by some, then it is distinctly harmful and dangerous, and should be cast aside in favor of surgery alone. On the other hand, if in the experience of competent radiotherapists the end-results of carcinoma of the breast following postoperative radiation show a greater percentage of clinical arrest of the disease, then such misstatements and reports as those I have mentioned should be put to rest at once, and ways and means devised to bring this knowledge home to each surgeon and physician who shares responsibility for the proper care of these patients.

In the first place surgical technique in cancer of the breast is about fifty years old, and whilst new technical refinements are evolved constantly, unfortunately the further outlook for improved radical surgical excision of the disease does not inspire any one with undue hope. The postoperative results familiar to us at present are none too satisfactory. For instance, at a meeting of the American Surgical Society at Washington, where the end-results of cancer of the breast were discussed, less than three weeks ago, it was brought out that the three year recoveries by surgery were 51 per cent, and that after five years about 70 per cent had succumbed. These figures correspond with reports from Sistrunk of the Mayo clinic, and others, that about 78 per cent of the cases of carcinoma of the breast do not survive the five year period, and those that do survive represent in a great measure the optimum surgical risk. They were cases of early localized tumors, with no glandular involvement at the time of operation.

It is perhaps pertient to mention right here that statistics, as a general rule, are a very unfair criterion, as we are speaking constantly of a collection of unlike things. So many different factors, that is, the extension of the disease, its duration since its incipiency, the biological behavior, etc., enter into this complex collection that it is impossible to assume them to be all of the same kind or put them into one group. Therefore it is not fair to use these statistics as a means of primary proof of a fact. They do not allow definite deduction as they can not be classified uniformly. In other words, figures mean little, and must be taken for what they are worth unless specifically qualified. To demonstrate, in the first place whilst as a general rule the tumor cell, microscopically or clinically, possesses the characteristics and peculiarities of its parent cell, on the other hand its degree of malignancy varies entirely, and is dependent either upon the resistance or susceptibility of the entire organism. Of importance in this connection is the distribution and duration of the disease since its incipience, also the extent of the involvement of adjacent structures, the involvement of glandular tissue, either in the axilla or neck or thorax, and most important is the difference in the biological behavior of one particular tumor from that of another.

For instance, in the consideration of the varied clinical manifestations of carcinoma of the breast, we are confronted with the following factors: In the one case it presents itself as a local condition, and remains local and stationary for a number of years, without the slightest general disturbance, and to all intents and purposes it is very slightly malignant until metastases occur elsewhere. In another group of cases, the growth though it starts as a localized tumor, spreads more or less rapidly either by extension along the lymphatics or blood stream, and springs up in different parts of the body. There is still another group in which the tumor develops perhaps in more than one site in the same breast; these different foci continue to grow and form eventually one large mass Finally in the fourth group the malignancy starts in one breast, and then affects the other, either after a very short interval, or almost at the same time. It spreads very rapidly throughout the body, and invariably ends fatally in a comparatively short period.

There are, however, a number of instances, especially in old people, in whom growth energy is reduced to a minimum, where the tumor may remain stationary for years. Particularly is this true of tumors which are not very cellular but are abundant in fibrous tissue, for as a general rule fibrous tissue tumors grow very slowly and simulate an attempt on the part of nature to retard the growth. Contrast this to the rapidly metastasizing group, analagous to the pyemic conditions of an infection. Here also we see the defensive or resistant mechanism of the organism so exhausted that it is practically powerless to stop or limit the growth energy of the malignancy. Unfortunately this happens all too frequently in the majority of cases of carcinoma of the breast.

This brings up the therapeutic consideration of the group of cases in which the tumor is local or remains local in the breast. This type, especially, lends itself very favorably, both anatomically and surgically, to radical excision, not only of the local tumor but also of the large field of threatened dissemination. These are the most promising cases prognostically, and offer absolute indication for early surgical interference. Recoveries and cures in this class of cases are of the optimum proportion.

It is regrettable as well as reprehensible that the majority of cases of cancer of the breast do not present themselves or seek advice at this period,

*—Read at the Midyear Meeting of the Radiological Society of North America, St. Louis, May 20, 1922.

but delay far too long. It is astounding in this connection that this applies not only to the ordinary patient, but to the wives and other members of physician's families. Let it again be repeated that it is essential to bend all efforts toward an early diagnosis. To temporize in any one of these cases forces it to be classed in the second group, where slow spreading and dissemination has already set in. In this group surgery used alone fails to remove all vestiges of tumor cells, no matter how wide and thorough the dissection be carried out. All surgical statistics are one where axillary or other lymph nodes are involved, namely, the number of women who survive the five year period is less than 30 per cent.

These are the very cases in which surgery plus postoperative radiation is of necessity indicated. Radiotherapy during the past two or three years has attained new heights, and as the result of this only intensive radiation is at present practiced, and with it accurate determination of a definite skin tolerance dose and its absorption in the deeper tissue is aimed at. So, too, the secondary scattering is carefully reckoned with, for all this makes for a better dosage quotient. It is pretty well recognized at present that the higher the voltage of a given apparatus, the greater will be the out put of short wave radiation, and consequently a larger percentage of harder rays quantitatively as well as qualitatively. Again the harder the ray the better will be the absorption coefficient; and the greater the amount of radiation that passes into the depth, the greater the scattering and hence the greater the biological effects. To gain a better understanding of the importance of high voltages, it should be borne in mind that the increased radiation is in proportion to the square of the voltage, that is, if we compare the relation of the 140,000 or 150,000 volt apparatus to the modern 220 kv. machine, the proportionate energy output is not a 40 per cent increase, but in the proportion of 1 to 2. With this enormous increase of radiation intensity of rays of short wave length the physical and biological effects are materially improved.

There is abundant evidence at hand clinically and experimentally that a definite amount of radiation exerts a definite influence, biological as well as pathological, upon cancer cells. Experiments, which I reported three weeks ago at the American Association for Cancer Research, upon the influence of tumor growth in animals by means of radiated tumor emulsion, proved that an emulsion of Flexner-Jobling Rat Tumor which was radiated with one or two skin erythema doses, failed to show upon re-inoculation, whilst in the control animals which were inoculated with the same emulsion unradiated, the tumor grew in 34 out of 43 inoculations.

My own clinical observation since the advent of the modern technique of intensive radiation within the past twenty months, has impressed it upon me that pre-operative or postoperative radiaion with proper technique will bring about much more gratifying end-results. This has prompted me to correlate my own experience with that formerly obtained by surgery alone. Therefore, I wish to report 73 cases briefly as the detailed protocol of these is being prepared for another communication.

In this report 73 cases of carcinoma of the breast treated by intensive radiation within the past twenty months are grouped as follows: Of this number 15 received pre-operative radiation and were operated upon twelve to fifteen days subsequently. In the majority of instances the pathological report read that the tumor *per se* had diminished considerably in size, in one case it had disappeared entirely upon gross inspection, and microscopical examination revealed necrotic or degenerated cells, showing simply a faint outline of the membrane of the cell without protoplasm or nucleus. In none of these has there been a recurrence so far. Of course, the time limit is far too short to claim any permanent results, however, at present, all of these 15 are clinically free of the disease. Of 23 other cases that received postoperative radiation, in all but 2 the disease is clinically arrested. Repeated radiographic examinations reveal no manifestation of the disease elsewhere. Nine months subsequent to the primary radiation one case developed metastases in the hip, which yielded to intensive radiation; the other case developed a small nodule, in the scar, which has since receded.

Twelve patients presented themselves with recurrences either in the scar or axillary or supraclavicular regions, anywhere from three months to eight years after the primary operation. Of this group two have died of multiple metastases elsewhere, one has developed spinal metastases. The other nine are enjoying good health, the local recurrences have disappeared and the disease is seemingly arrested.

In conjunction with this group of 12, there were 8 others who at the time they first sought relief presented extensive glandular involvement, and in 2 cases there was ulceration and necrosis of the entire breast. These were all inoperable. Of these 8, 2 cases were rendered operable, and it seemed wise to give them the benefit of radical surgical excision of the breast, which was followed by intensive postoperative radiation. The other 6 were radiated only. Four are still alive in good condition, the ulcerations have healed, and the glands receded. One is clinically well after fourteen months, the other three after six to eight months. They have gained in weight and to all intents and purposes enjoy good health.

Fifteen cases were treated for metastases subsequent to primary radical excision of the breast. This group comprises 2 cases with metastases in the spine, 2 of the hip, 5 of the opposite breast, 2 of the supraclavicular glands of the opposite side, 3 with mediastinal metastases, and 1 case of metastatic skin nodules. Nearly all of these cases were in an absolutely hopeless condition. Of this group 9 are dead, 6 are still alive, 3 clinically free of the disease at present. In only 2 cases, however, could the radiation be said to have been of no avail.

In connection with this report I wish to mention 8 cases radiated immediately after the operation (prior to the modern intensive treatment) which have remained well from four to nine years. During the same period 14 cases were treated with the old technique for recurrences, all but three have succumbed.

	No. of Cases	Clinical Arrest	Favorably Influenced	Not Influenced	Dead
Pre-operative	15	15	0	0	0
Postoperative	23	21	2(1)	0	0
Recurrent following operation	12	9	0	1	2
Distant metastases following operation	15	3	0	3	9
Primary inoperable	8	4	2(2)	0	2
Total	73	52	0	4	13

(1)—One case developed metastases in hip, which receded under radiation. Another case developed recurrence in scar, which also receded under radiation.
(2)—Two cases were rendered operable by th intensive radiation, and radical surgical excision was performed.

From this brief clinical report, it is obvious that pre-operative and post-operative radiation, though it has not accomplished a clinical cure in every case, has surely exerted a most beneficial influence upon the outcome of these cases. It is difficult to conceive, moreover, how radiation can be made responsible for postoperative recurrences if no cancer cells were left behind at the time of the radical surgical excision of

the tumor. On the other hand, if in the experience of some surgeons the percentage of postoperative recurrences was enhanced by prophylactic radiation, it would serve to prove that in spite of the most extensive operation, cancer cells were left behind to resume active proliferation, and hasten recurrence. Just in these cases it is paramount to proceed with intensive radiation in the form of a complete carcinoma knock-out dose, in order to destroy the cancer foci in the areas inaccessible to the knife. In other words, this is the very type of case in which recurrence is sure to follow if no radiation is instituted, and if intelligent and adequate radiation fails to prevent recurrence, it can be attributed to the presence of cancer cells, which proved resistant to the ray, as well as inaccessible to the knife.

Of course, there is one argument which may be advanced by the adversaries of postoperative radiation, namely, that the cancer cells which were left behind at the time of operation, may be brought to greater activity by radiation, and become stimulated. If this should occur it would be because of an error in radiation dosage. This kind of error in technique is to be guarded against, and strongly condemned, though an error in technique cannot count as an argument against radiation, any more than an error in surgical technique can count against surgery.

The proper dosage of radiation will destroy cancer cells left behind at the time of operation, and the time has come when the surgeon and the radiotherapist should decide the best means of dealing with a given case of cancer of the breast. It is my impression that the best interests of these cases of carcinoma of the breast have not been served unless they have received the combined aid of the surgeon and radiotherapist.

The Practical Dosage of X-Rays*

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IN the practical dosage of x-rays two questions have to be considered:

1. How can we apply to the skin a known dose of radiation that will produce a certain bilogical reaction?

2. What is the best way to find the intensity at certain points in the depth in comparison to the intensity on the surface.

Let us consider the first question. This is a very important question for the radiotherapeutist who is starting x-ray therapy and who intends to apply the proper erythema dose without danger to the patient. It is very interesting to compare the different erythemas given by different physicians, especially as the energy used for the erythema of the skin is generally regarded as the unit for the energy sent into the body. The usual comparisons of the intensity and hardness of the radiations stating the kilovoltage, the milliamperage, the filtration and so on, do not satisfy the requirements of exactness. This may be shown by the following examples:

With 200 kv., 1 mm. Cu, focal skin distance 50 cm. Dr. Schmitz gives as strongest possible erythema 450 ma. min.

With 220 kv., 1 mm. Cu, focal skin distance 50 cm. Dr. Tyler gives 450 ma. min.

With 200 kv., 1 mm. Cu, focal skin distance 50 cm. another clinic gives nearly 800 ma. min.

With 200 kv., ½ mm. Cu, focal skin distance 50 cm. Dr. Smith gives 500 ma. min.

In the last case a shorter time of application ought to be expected, as with the lower filtration the intensity should be larger and the rays should be softer. How may one avoid such discrepancies?

If we want to answer these questions and to make physical measurements, the following difficulty arises: The relation between the intensity, measured by physical instruments and the biological effect changes with the hardness of the rays. For instance, the amount of energy which produces a certain erythema, measured as F-units with the Fuerstenau Intensimeter is about 70 F with soft rays, with hard rays about 400 F; in a similar manner when using the Kienboeck strips the amount of 10 x-units has to be applied for soft rays and about 40 x-units for hard rays. With these old methods of measuring the intensity, the hardness cannot be determined exactly and is usually expressed by the kind of filtration used. Therefore, it is not known at all which amount of F or X is necessary for an erythema.

To overcome these difficulties two methods have been applied. One method originates with Professor Friedrich in Freiburg. His intention is to reduce the error of the hardness to a minimum by using small chambers of different materials, different sizes, and different thicknesses of the walls in his experiments, and thus eliminate this error within a certain range of rays. With the usual instruments, the ionization chambers (also used here in America), the error is not totally eliminated. This was proved by measurements, which I made in the Chicago Institute of Radiation Therapy, with one American apparatus and two German ones.

If we know the time of discharge, measured in seconds, we have to multiply this time by a certain factor in order to calculate the time necessary for an erythema skin dose. This factor is not constant, but varies according to the hardness of the rays. For example (Table I), with 130 kv. and 0.5 mm. Cu the time measured with our own iontoquantimeter has to be multiplied by 3 in order to give the number of minutes that produce the Schmitz erythema skin dose. In working with 200 kv. and 1 mm. Cu we have to multiply by 4 in order to produce the same erythema. With another iontoquantimeter, which was standardized by us biologically, the factors were 4.6; 5.0; 5.3 for different hardnesses. With an American instrument containing a small paper chamber the factors were 1.8; 1.7; 1.6, which means that the error is reversed. Unfortunately, it is not possible to determine the hardness of the rays with the iontoquantimeter independently of other factors, such as the focal skin-distance, size of the field and so on. These factors may vary with the different investigators.

In order to compare the intensities and hardnesses of different transformers I have constructed a transportable electroscope (Fig. 13) which works so constantly that all measurements can be compared. The only movable part of this instrument is an aluminum leaf which is deflected by the electric charge. This instrument will soon be standardized in "e" units so that it can deliver also absolute physical values. The electroscope was standardized by the different machines which Dr. Schmitz uses, on the basis of different known skin erythemas, characterized by epilation, so that the erythema factor for all hardnesses is known as exactly as biological observations permit it. The

*—Read at the Midyear Meeting of the Radiological Society of North America, St. Louis, May 20, 1922.

curve in Figure 1 shows how the factor depends upon the hardness. The hardness is defined exactly by the total absorption factor μ. The comparative measurements of different hard rays were made in Bonn. By these investigations it is possible to compare the energies of erythema that have been given by different authors with different hard rays. The different sizes of the fields are not considered in these measurements, though they give different results. If we consider these factors the result would be that the erythema dose which was applied in Bonn is 1.7 times as large as the unit dose of Seitz and Wintz, and that the dose of Warnekros and of Borell is still 1.4 times larger than the first dose. Such measurements would be of great importance in relation to the different bilogical effects. The main importance of the double measurements of intensity and hardness which can be obtained with the electroscope is the fact that the erythema time can be predetermined for every hardness.

For the determination of the x-ray intensity in the depth I could demonstrate two methods. I should like to differentiate them as the direct and the indirect method.

The direct method consists in determining the depth dose with the iontoquantimeter under the same conditions as obtained during treatment, namely, with a known kilovoltage, milliamperage, filtration, focal skin distance and port of entry. This can be done on the patient or with a water phantom. Of course, the depth dose will only be known at certain points, generally in the depth of 5, 10 and 15 centimeters. The calculation in other depths of the central beam can then be made by using the law of squares and the exponential law of absorption. The best method would be to put down these results in a system of curves and to use them according to the focal skin distance and the deep quotient in question. In the following figures the curves are drawn for different deep quotients (30, 40, 50 per cent), as calculated and measured by different methods. Figure 2 shows curves for deep quotients from 30 to 60 per cent, which are drawn exactly according to the exponential law of absorption. These curves can be calculated and drawn very quickly but they neglect the law of the square of the distance. If we regard this law for 30 and 50 cm. focal skin distance, we get the curves in Figures 3 and 4. This calculation shows, that even by the hardest rays no higher deep quotients than 54 and 69 per cent are possible. The dotted curves correspond exactly to the law of the square.

Besides these calculated curves I should like to show you curves which are obtained by measurements. Using the different Dessauer charts at 50 cm.

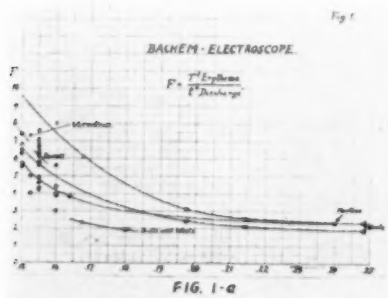

FIG. 1-a

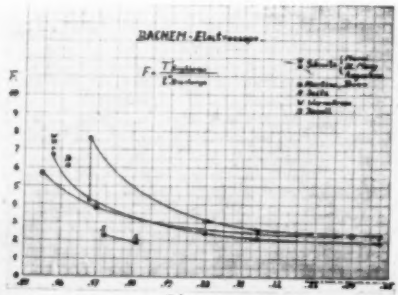

FIG. 1-b

Tab. 1.

Erythema-Factors.

KV.	Filter	Erythema Time.	Ionto I	quanto II	meter III	Electro scope
200	1.00	85'	4.0	5.3	1.6	5.7
175	0.75	71'	3.7	5.0	1.7	5.0
130	0.50	120'	3.0	9.6	1.8	2.7

TABLE 1

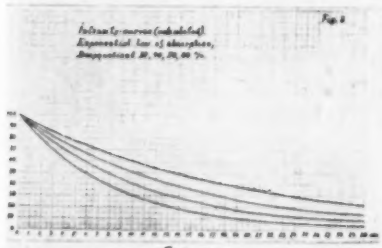
FIG. 2

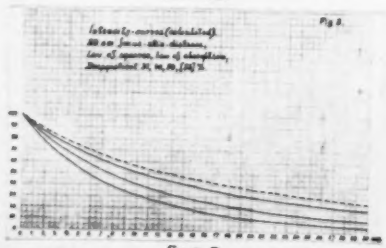
FIG. 3

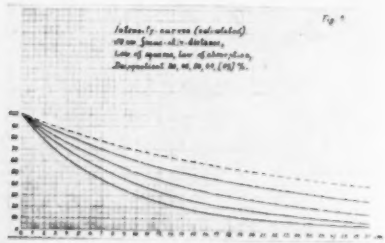
FIG. 4

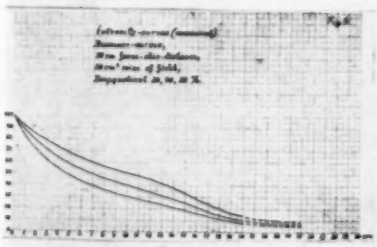
FIG. 5

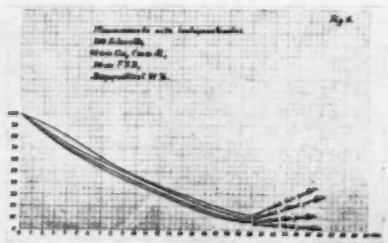
FIG. 6

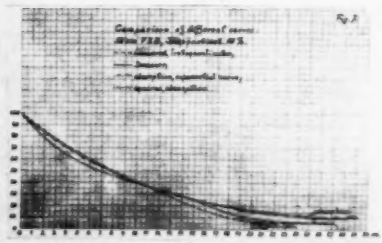
FIG. 7

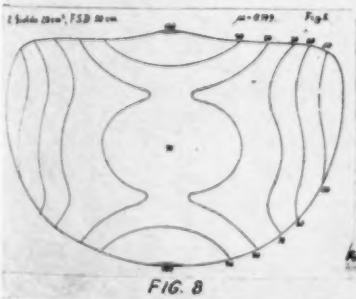
FIG. 8

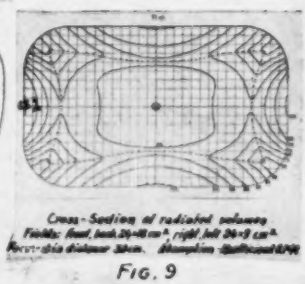

FIG. 9

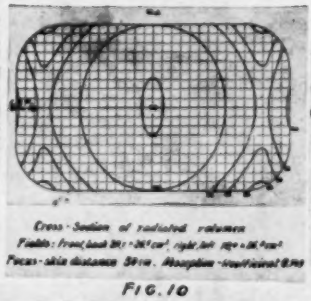

FIG. 10

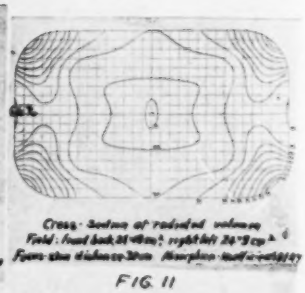

FIG. 11

focal skin distance and large fields and different hardnesses, we can draw the following curves for 30, 40 and 50 per cent deep quotient (Fig. 5). They differ very much from the former ones. Generally the result is a better one in so far as at the center a greater intensity is to be found, and at the end the intensity decreases rapidly. That is produced by scattered radiation, which is especially active in the interior of a large radiation cone. Similar curves can be obtained by measurments with the iontoquantimeter. Of course, the measurements have to be exact. On the surface of the water phantom we have to place a layer of paraffin of half the thickness of the diameter chamber; if we measure in the deep, a layer of paraffin of the thickness of the chamber must be used. Further, we have to consider the undesired radiation. Correcting the latter we get a deep quotient somewhat smaller than without correction. As the time is too short I cannot talk about the different stages of the exact measurements. The results of the different measurements are shown in Figure 6. The curve obtained by not using the paraffin on the surface looks and really is wrong. The other curves differ only by the value of the deep quotient. In the center they all run nearly straight and at the end they have very small values, nearly the same as those of the Dessauer charts. It is very interesting to compare the different curves for the deep quotient of 40 per cent. All curves show characteristic differences. The measured curves coincide at least two points in the depth. After having determined in this manner with sufficient exactness the distribution of the intensity along the central beam we are enabled to combine two radiation cones, for instance, an interior and a posterior one. We can calculate what intensity is given in the deep and we can find what intensity is sent through the body by each field. For instance, with a patient of 20 cm. diameter, and using a certain radiation, 10 per cent reach the opposite side of the body. In order to produce the same erythema, as with one field, the time has to be reduced, so that instead of 110 per cent only 100 per cent strike the skin. Then the full amount of the two deep quotients does not reach the depth, but only the percentage which is reduced in the same ratio. It follows that with two fields 100 per cent can never be sent into the depth, as is so often incorrectly claimed. Therefore if we want to produce a large effect in the depth two possibilities are given:

1. A very strong erythema must be given, so that less than 100 per cent, about 80 or 85, would be sufficient to destroy the cancerous tissue.

2. More than two fields, four fields for instance, can be given. Then the focal skin distance may be shortened to 30 or 40 cm., and again the time of each application has to be reduced, so that the skin may not be injured by the full amount. Radium may be used in both cases also.

However, the addition of four fields is impossible, if only the intensities of the central beam are known. The distribution on the periphery and without the fields must be known. It is scarcely possible, by our own measurements, to measure the distribution of the intensity in all the radiated and not directly radiated areas by the direct method. Such measurements have been made with very great exactness and completeness in the Institute for the Physical Foundations of Medicine in Frankfurt on the Main. The results have been published in the Dessauer charts. These charts consider all possibilities such as different focal skin distances, different sizes of the fields, and different hardnesses. If both geometrical facts are given, for example 50 cm. focal skin distance, 20 cm. port of entry, the hardness has to be known also, either as the total absorption coefficient μ, or as the deep quotient. Then we know what charts have to be used. Knowledge of the kilovoltage is not sufficient, as I have demonstrated before. In Germany the kilovoltage is measured very differently, therefore quite great differences arise. The best way is either to measure the deep quotient by a correct iontoquantimeter under well known conditions and to select the Dessauer charts with these values, or to measure the μ by an electroscope.

Using the Dessauer charts we are able to find the distribution in the depth, even if we combine three or four fields for every desired point in the interior and on the surface. Some examples

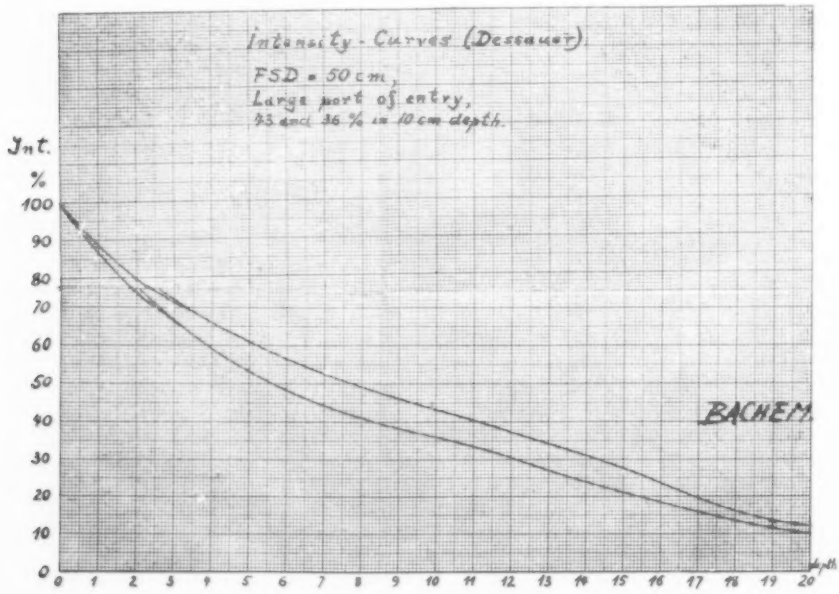

Fig. 12

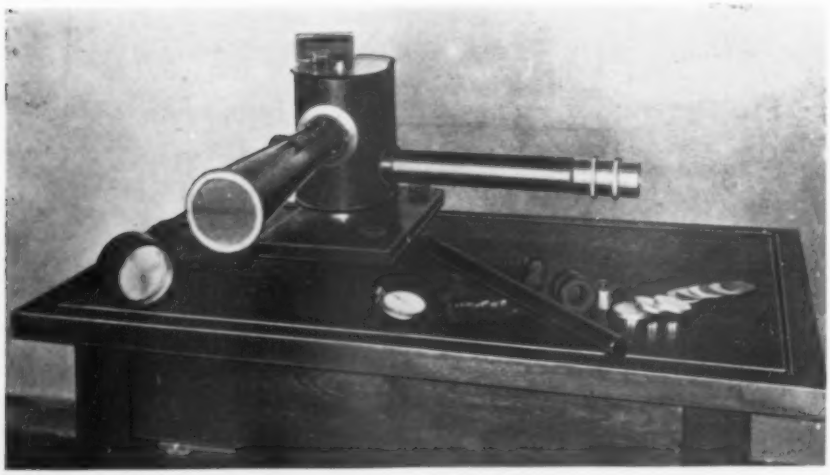

Fig. 13

may show you the results of different methods of treatment (Figs. 8-11).

By such figures and by special investigations we can find what are the best and most economic conditions for practical treatment and what amount of radiation in each case is sent to each point. The last method, to define and to find the necessary three factors, and then to use the given exact measurements may be called the indirect method.

You see, gentlemen, how it is possible today to give a correct dosage. What I have explained to you in this short paper is not a certain method that I would like to recommend to you—it is very indifferent which method you use.

The chief factors are to give an exact physical skin dose, a dose which always remains the same, or which is always known, and to know the intensity, which is given at important points in the depth. Only when the physical dosage is given correctly in this manner is the comparison with the biological result possible. Then only is a real scientific investigation of the biological effects of x-rays possible and then only does it promise to be successful.

ULTRA VIOLET RADIATION

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PHYSIOCHEMICAL reactions, particularly those induced through the influence of radiant energy displayed on biologic structures, must be interpreted in terms of electronic behavior. Speaking generally, it is correct to assume that the physiological effects of ultraviolet energy have their origin in the photochemical reactions produced when the energy is absorbed. In the case of simple organic compounds *in vitro*, ultraviolet radiation, depending upon its constituent wavelength, acts as a powerful oxidizing and reducing agent; and so we may suppose that with the more complex chemical compounds whose totality represents the living cell, the same is true.

Thus, obviously, whatever are the therapeutic benefits derived from the use of ultraviolet radiation they are qualities governed by the characteristic absorption of the energy [1] as expressed by the photochemical law of von Grotthus, that "Only the radiation that is absorbed can effect chemical change." It must be observed that while we may know much on the topic of ultraviolet absorption by tissues, this does not at all explain how the radiation is successful in bringing about clinically established improvement and remedy of diseased states. But we do gain a clearer insight into certain fundamentals that, though they fail to explain some empiricisms, indicate definitely the avenues of scientific approach for future research and investigation.

When ultraviolet radiation strikes a tissue surface, as for example, skin, one part is absorbed, another is reflected, a third is transmitted. Assuming the original intensity of the incident ray to be I, and A, R and D to represent, respectively, the amount absorbed, reflected and transmitted, then,

$$I = A + R + D$$

As we have seen in the study of the cosine law, the incident intensity of ultraviolet is greatest when the ray strikes the surface at a right angle. In proportion as the incident ray assumes a direction less than 90 degrees, the amount reflected is greater and greater. This loss by reflection is an important clinical consideration and may be compensated by suitable increase of the exposure time, about as follows:

Angle of incident ray to plane of surface treated	Compare with exposure time; or fractional increase required
90°	0
75°	1/10
60°	1/5
50°	1/4
45°	2/5
30°	1/2

That is to say, an exposure that will produce a given erythemic reaction in sixty seconds with tangential illumination, will require, to produce the same degree of erythema when the incident central ray is oblique:

Incident Angle	Time Seconds	Compensatory Increment		Total time Seconds
90°	60	0	0	60
75°	60	1/10	6	66
60°	60	1/5	12	72
50°	60	1/4	15	75
45°	60	2/5	24	84
30°	60	1/2	30	90

The amount of light reflected by a surface on direct illumination was designated by Lambert as albedo; and we may similarly introduce the term actinic albedo for the increased reflection coming from oblique illumination. For the angles given, therefore, the fractions represent "actinic-albedo corrections."

When the maximum absorption of ultraviolet energy is assured by minimizing the reflected portion through tangential radiation, or through extended radiation time measured according to the actinio-albedo constant, we are next concerned with the changes assumed by the absorbed energy.

Very broadly, the shorter the ultraviolet wave lengths, the greater the absorption by any given medium. Studying the penetration in microns for skin irradiated with ultraviolet, we find a rather even decrement in micron penetration as the wave lengths become shorter; but when a certain limit is reached, the relation between shortness of wave length and extent of penetration no longer obtains. This is exemplified in Figure 1. Observe that the skin penetration becomes proportionately less as the wave lengths of ultraviolet become shorter; and that in the region of 2,900 Aengstrom units, the penetration is indeed slight and varies little with subsequent shortening of the wave length. We may speak of this phenomenon, which is characteristically shared by all tissues, as the "extinction coefficient;" and we find that each tissue and protoplasmic unit has its characteristic extinction coefficient, which, for skin, is 2,900 Aengstrom units.

It is significant to observe that the extinction coefficient for skin is located in the ultraviolet region representing the extreme limit of the ultraviolet spectrum reaching us from the sun. This is a critical point; for the action on the human economy derived from wave lengths shorter than the extinction coefficient limit can no longer be due to anything other than barest superficial activity. Expressed biophysically, ultraviolet radiation of wave lengths longer than about 2,900 Aengstrom units attacks atomic and molecular vibrations; and wave lengths shorter than 2,900, attack electronic vibrations (photo-electric effects). These differences reveal themselves therapeutically, and have led to the modern concept of ultraviolet usage in which the near ultraviolet region is considered biotic, the far ultraviolet region abiotic [2] in action.

Recently, from the work initiated by Koeler and later elaborated upon by Barnard, it has been shown that certain cell structures absorb greater quantities of ultraviolet energy than others; and that if unstained tissues are examined under a quartz lens microscope "illuminated" with ultraviolet, the struc-

tures that absorb most of the energy are more opaque than those absorbing less. Since a photographic emulsion is sensitive to ultraviolet radiation, this difference in the absorptive capacity of various structures of the cell is beautifully revealed. Bayliss, in his "Principles of General Physiology," gives the accompanying illustration, which is self-explanatory (Fig. 2).

It will be noted especially that the nuclear or "chromaffin" structures of cells are particularly affected by biotic ultraviolet radiation; which leads to this premise:

Imagine two cells 80 microns in diameter with centrally placed nuclei. Suppose a ray of biotic ultraviolet energy [3] strikes the first cell tangential to its surface; and a ray of abiotic [4] ultraviolet radiation similarly strikes the second cell. In the first case, the long ultraviolet wave lengths reach the nucleus and accelerate its activity. In the second case, only the ectoplasm of the cell is reached, where coagulative changes (Bovie) are induced, so that even the normal products of cellular activity can no longer pass through the cell wall, which alone has been modified. A sketch (Fig. 3) will make this clear.

If instead of a single cell we imagine a number of layers of cells 80 microns deep, obviously the effect is intensified. So that long ultraviolet radiation displays a maximum effect on the nuclear or chromaffin structures, accelerating their function, and therefore inducing such physiologic reactions as may depend upon increased chromaffin activity. Short ultraviolet wave lengths, by attacking the limiting membrane of the cell and thereby changing its osmotic propensities, provoke physiologic reactions in which the virtual elimination of nuclear function is characterized. This has been summarized in the expression that long ultraviolet wave lengths are metabolic stimulators, and short ultraviolet wave lengths are metabolic depressors. Or, nuclear physiology may be increased or eliminated, depending upon whether long or short ultraviolet wave lengths are used. Since the oxidizing and reducing qualities of cellular action are centered in the biochemistry of the nucleus the basis for classifying the energy into "oxidizing" for long wave lengths and "reducing" for short wave lengths, is again revealed.

Metabolism represents a reaction between a force and a resistance. The force, dominantly chemical in origin, is derived from two sources, which are:

1. Intrinsic.
2. Extrinsic.

Intrinsic sources include the breaking down (katabolism) and building up (anabolism) of foodstuffs ingested for the upkeep of the economy.

Extrinsic forces include the climatologic influences of the environment in which the living structure is immersed, for example, air and radiant energy supplied as visible energy (light) and invisible energy (infra-red and ultraviolet rays).

All the laws regulating the operation of these intrinsically and extrinsically derived forces are entirely subject to the fundamental principles of energetics; from the study of which we may conclude that the breaking down and building up processes involve three factors, namely, a chemical force, a chemical resistance, and a chemical velocity. Metabolism being in this manner reduced to a chemical mathematical expression, we find that it involves:

(1) Fc = Chemical Force.
(2) Rc = Chemical Resistance.
(3) Vc = Chemical Velocity.

so interdependent as to bear the following relation one to another;

$$(a) \quad Vc = \frac{Fc}{Rc}$$

From which,

$$(b) \quad Fc = Vc \times Rc$$

That is, the inherent chemical force operating in a given instance is the product of the velocity of chemical reaction times the chemical resistance. Those entities in which metabolism is below par are expressions of diminished chemical force or increased chemical resistance. Those cases in which the metabolic rate is above normal are an expression of an enlivened chemical force or accelerated velocity of reaction.

Considering the entire epidermal integument of an individual as an organ contributing liberally to the metabolic integrity, it is at once obvious what may be expected when the environment is suddenly changed chemically, or, what amounts to the same thing, when the organism is subjected to a flood of ultraviolet radiation. Such terms as "constructive energy," "chemical energy," used synonomously with ultraviolet energy, show the heretofore empiric endeavor to describe the peculiar effect of ultraviolet radiation on the regulation of metabolism. Viewed in the light of the energetic theory propounded, it is interesting to observe how an increase in any of the factors (Fc, Vc and Rc) involved in metabolism may influence the trend of metabolic balance in the individual. In the equation

$$Fc = Vc \times Rc$$

Suppose that there be assigned arbitrary values, as follows:

$Fc = 8$
$Vc = 4$ or $Fc = Vc \times Rc$
$Rc = 2$ $\qquad 8 = 4 \times 2$

This, it will be assumed, represents the division of energetics, or the metabolic state of an hypothetical case. Under the long wave lengths of ultraviolet radiation, the chemically active fraction (nuclei) of many cells is increased; which is the equivalent of saying that the chemical force is augmented. If the chemical force is doubled, there must be corresponding changes in either the chemical velocity or the chemical resistance to satisfy the equation; or, under long wave length ultraviolet radiation, if instead of Fc being equal to 8 units, Fc = 16 (or 8 doubled) then,

$$Fc = Vc \times Rc$$
$$16 = 8 \times 2$$

Supposing instead that short or abiotic ultraviolet wave lengths are used. By their ectoplastic coagulation they eliminate the contribution to metabolic function by isolating the products of nuclear activity. The increase in chemical force operating on the ecto-

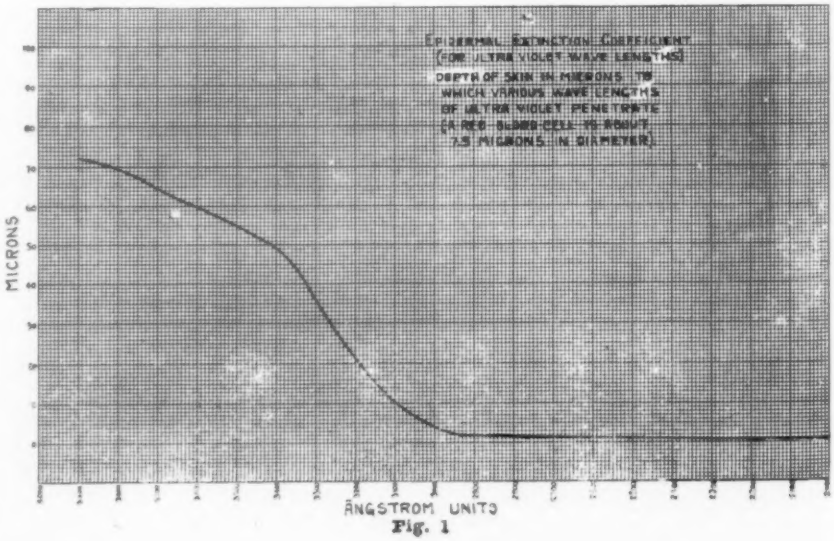


Fig. 1

plasm, mostly, changes the velocity of reaction by increasing chemical resistance; when,

Fc = Vc x Rc then 16 = 2 x 8

Metabolism (in certain of its phases) is an expression of the chemical forces operating with speed against a resistance. Near ultraviolet increases the speed; far ultraviolet increases the resistance. Or, in the language of the clinic, near ultraviolet energy is a metabolic accelerator and far ultraviolet energy is a metabolic depressor. Of course, there are many additional factors that must be considered in connection with the action of ultraviolet, as, for instance, the effect upon the enzyme content of cells. But these are not immediate problems in absorption and must, therefore, be relegated to subsequent presentation.

Beside reaching depths of 70 or more microns in cellular structure, the near ultraviolet radiation meets also, in its passage through the cell layers, capillary blood and lymph. Both are strong ultraviolet absorbents, as Finsen originally demonstrated. But their response to ultraviolet energy is only indefinitely known.

Speaking first of the blood, there may be considered:

(a) Red blood cells.
(b) White blood cells.
(c) Plasma.

The plasma is conceived as a colloidal solution of proteins and salts in which ultraviolet absorption depends upon five factors:

(1) Chemical nature of dispersion phase.
(2) Concentration.
(3) Degree of dispersion.
(4) Particulate content.
(5) Structure and character of contained particulate surfaces.

These many and complicated factors governing the absorption make the complete appraisal of the biophysics involved a most intricate group of problems, few of which have yet been solved. For example, Tadokoro investigated the antagonistic action of salt in blood serum; and he found that the ultraviolet absorption may be influenced by the reversing action of the serum dispersion which comes from the simultaneous presence in the serum of two salts. Together with Nakayama, Tadokoro found also that as the serum concentration decreased, its transparency to ultraviolet increased. They showed also that an immune serum holds from two to ten times greater absorption limits in the ultraviolet region, as does a normal or non-immune serum.

This increase in the limits of ultraviolet wave length absorption in the serum is observed as a result of repeated bodily irradiations, and expresses, probably, what clinicians report when they speak of the "general raising of immunity" incident to systemic actinic radiations.

Hemoglobin absorption spectra are well known from their constant reappearance in general physiology treatises. As hemoglobin undergoes changes under the functional activity of respiration, it changes to various loosely combined products, of which we may mention oxyhemoglobin and carbon dioxide hemoglobin. There has been found a shift of the limit of ultraviolet absorption, and visible light absorption, which plays a peculiar role in the physiology of respiration, as follows: Changed hemoglobin absorbs a greater limit of ultraviolet and visible light than unchanged hemoglobin. The limit is extended by a shift which includes longer wave lengths. From which it appears that as soon as hemoglobin suffers whatever chemical change (oxyhemoglobin, methemoglobin, reduced hemoglobin, carbon dioxide hemoglobin, etc.,) incident to the transportation of oxygen from the lungs to the tissues, or back from the tissue to the lungs, this incites an ability on the part of the changed hemoglobin to become responsive to an increased range in the ultraviolet spectrum and some parts of the visible spectrum. By this increase, a greater chemical force is exerted in the blood pigment which leads to the dissociation of the hemoglobin and therefore prepares it for the renewed dispatch of its oxygen carrying capacity.

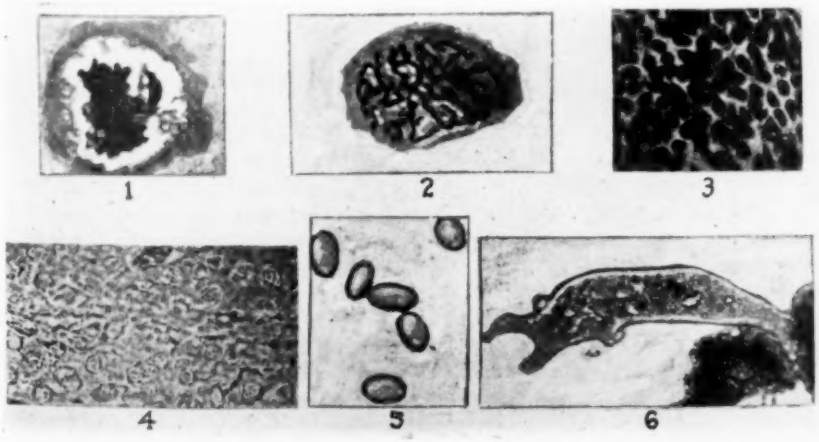


Fig. 2—Nos. 1 and 2—Dividing nuclei from gill plate of salamander larva. Unstained, in glycerol. Photographed with ultraviolet light of 280 *uu*. The chromatic substance appears as if stained. No. 3—Edge of sternal cartilage of newt. Living. Photographed with ultraviolet light. The nuclei are opaque. No. 4—The same photographed with ordinary light. The nuclei are transparent. No. 5—Red blood corpuscles of the newt. Living. Photographed with ordinary light; although oblique illumination was used the nuclei are almost invisible. Traces of diffraction are seen around the corpuscles. No. 6—Ameba. Living. Photographed with ordinary light; the nucleus is just visible, but transparent. (Nos. 1 to 3 after Koeler.)

It must not be assumed, as some have contended, that ultraviolet energy is absorbed by the blood, and as such, is conveyed for distribution to various parts of the body where it may be again emitted. This concept is implied in the following experiment, somewhere recorded: "One of these films (a dental x-ray film is meant) was placed upon the back of the thigh in the dark room and covered with black photographer's paper of several thicknesses and strapped on with adhesive straps covering the edges of the paper and the surrounding skin as well. There was obtained a distinct fogging of the film after an exposure of three minutes to a mercury vapor lamp held in front of the leg opposite the film. To see if this was the result of straight penetration or of secondary radiation from the blood stream, another film was fastened in the same place and the opposite shoulder exposed to ultraviolet with the film and rest of the body carefully protected from the ray. The same fogging resulted." [5] Even a superficial knowledge of the physics of ultraviolet radiation is sufficient completely to refute the validity of statements such as the one just quoted. Visible light, some regions of which affect an x-ray film, can pass through various thicknesses of tissue measured in inches. Ultraviolet radiation is, of course, quickly absorbed in depths that approximate one-thirtieth of one inch; and when waves are absorbed their identity as a wave motion is entirely lost, the impact of the wave motion on the absorbing medium inducing certain biophysical changes. The products of the biophysically induced changes may be carried around in the circulatory stream; but this is radically different from the thought conveyed in the quotation.

In view of the difficulty that attaches itself to the problem of ultraviolet absorption, a correct understanding of

which will make intelligible the therapeutic applicability of the energy it becomes necessary that there should be presented the more recent summary of the physics of ultraviolet absorption.

When a ray of ultraviolet radiation traverses an absorbing substance, a certain proportion is absorbed. The proportion is independent of the *original* intensity; the amount absorbed is proportional only to the *incident* intensity. Also, the amount absorbed is the quantity represented by the equation:

$$A = \frac{I_0 - I}{I_0}$$

Where A = amount absorbed;
I_0 = incident intensity;
I = amount transmitted.

Or, in another form, the transparency constant of a substance may be expressed as:

$$\frac{I}{I_0} = T$$

Where T is the transparency. Now, it follows that in a homogeneous medium, and with monochromatic light, if the thickness increases in algebraical proportion, the light transmitted decreases in geometrical progression. Suppose I be the intensity of a small layer traversed by ultraviolet, d c, then—

$$\frac{d\,I}{d\,c} = K\,I$$

On integration, this gives, when I_0 is the original intensity and d the total thickness—

$$I = I\,o\,c - k\,d$$

the constant depending upon the nature of the substance and the wave length of the ultraviolet energy.

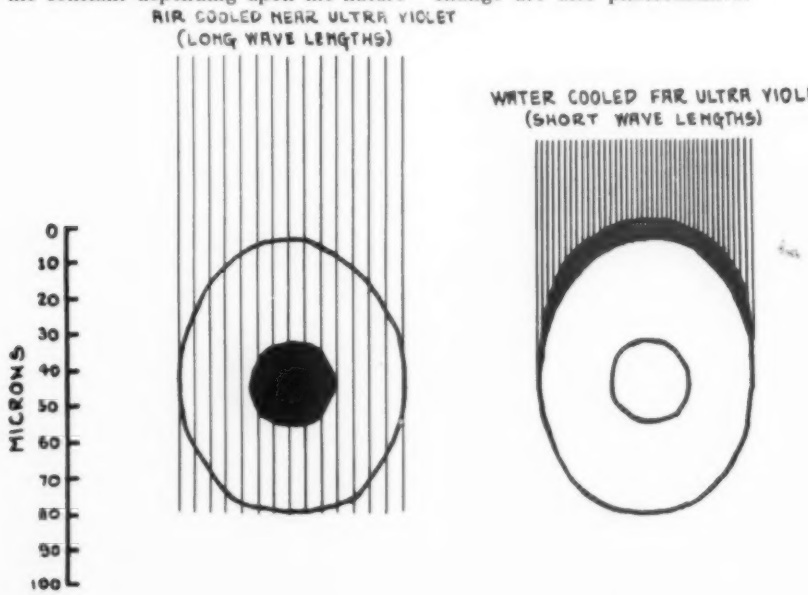
Beer's Law

It was deduced by Beer that absorption is the same function of the concentration of a dispersed absorbing substance as of the thickness of a single substance. The material upon which this law was propounded is rather inadequate; the law having in some instances been confirmed, in others not. In the case of solutions, the situation is about as follows: Solutions may be molecular dispersoids or lower degree dispersoids, being in the first case true solutions, in the latter, colloidal solutions (Ostwald). Differences in concentration of the solution should not affect the condition of the dispersed substance in order that the law might be valid; and this situation, in the case of biologic fluids, does not at all obtain. In solutions, the absorption is influenced by a number of factors, as for instance,

1. Changing concentration of the solvent (blood stream before or after a meal).

2. Influence of temperature (as in febrile pathology or physiologically induced heat changes through diathermy).

Not only does the concentration of the blood stream, as influenced by its water content in the ascites incident to cardiac insufficiency, and the chyle content after digestion, affect the absorption of ultraviolet because of the colloidal constituency of the serum, but the products carried to and from the tissues in the course of metabolism exchange are also photosensitive.



DIAGRAMMATIC REPRESENTATION OF THE CELL STRUCTURE ATTACKED BY LONG AND SHORT ULTRA VIOLET WAVE LENGTHS, IN THE FIRST CASE, THE NUCLEUS IS ATTACKED, IN THE SECOND, THE ECTOPLASTIC MARGIN. BASED ON THE EXTINCTION COEFFICIENT STUDIES (PENETRATION IN MICRONS) FOR SKIN. PACINI.

Amino-acids behave peculiarly toward ultraviolet energy, as Soret, Kober and Harris and Hoyt have shown. Speaking generally, these observers find that the ultraviolet wave lengths not absorbed by tyrosine and phenylalanin are relatively non-toxic for protoplasm; which means that the toxic, or abiotic region, lies between the limits of 2800-2400 Aengstrom units.

That the ingestion of certain protein foods is followed by marked hypersensitiveness to light is an established observation. Eggs, maize, and buckwheat are best known examples. An examination of the amino-acid composition of the proteins of these foods [6] shows them to contain high percentages of phenylalanin and tyrosin as compared to proteins obtained from other foods; and this may explain the factors involved in the mechanism that occasions photosensitization.

Enough has been given to show how intricately complex is the absorption of ultraviolet energy in tissues, from which studies we may reach tentative conclusions, as follows:

1. That long ultraviolet wave lengths are molecular and atomic in their attack, influencing especially the nuclei of the cells they reach.

2. That short ultraviolet wave lengths are electronic in their effect, striking particularly the ectoplasm where they occasion coagulative changes that make the cell more impermeable to osmosis.

3. That through these actions, the one derived mainly from air cooled lamps, the other from water cooled lamps, the regulation of metabolic pace is had according to the equation—

$$Fc = Vc \times Rc$$

4. That the biotic effects of the long ultraviolet radiation depend upon the complicated phenomenon of absorption, involving—

(a) Cytoplasm.
(b) Nucleus.
(c) Blood (capillary).
(d) Lymph.

5. That the *original* intensity of the lamp is not the measure of clinical efficiency, but this measure is the incident intensity, as modified by the cosine law.

For substances other than tissues, the regional transparency to ultraviolet should be known, as their use for selective filtration might be desired. Luckiesch gives the following table:

Natural blue rock salt	beyond 2250
Natural rock salt colored by cathode rays	beyond 2250
Natural rock salt colored blue by cathode rays	beyond 2250
Sylvite, white	beyond 2250

Chili saltpetre, ordinary white variety	3512
Chili saltpetre, violet	3248
Fluorspar, colored deep violet by cathode rays	beyond 2250
Diamond yellow	3200
Diamond blue	3150
Kunzite	3050
Garnet	4023
Zircon (hyacinth) red brown	2618
Zircon, decolorized by heat	2442
Zircon, green	4023
Zircon, yellow	4023
Topaz, pale yellow	2618
Topaz, dark yellow	2294
Topaz, pale pink-brown	2618
Topaz, blue	2961
Emerald	3200
Ruby	3000
Tourmaline, green	beyond 3512
Tourmaline, green-yellow	3000
Tourmaline, pink	3064
Spinel, blue	4023
Spinel, purple	3248
Spinel, pink	3000

For the transmission characteristics of various special glasses used as ultraviolet filters, the Corning Glass Works, Corning, N. Y., and the firm of Schott and Genossen in Jena furnish detailed information.

Having in the first of this series presented the factors in the generation of ultraviolet energy; in the second, its modification incident to the conditions under which it is used; and here, some of the principles involved in its absorption, we are better prepared to understand how ultraviolet energy operates in pathology, and to this understanding the studies subsequently presented will be directed.

FOOTNOTES

1. Any discussion of "ozone" inhalation and psychic influence claimed as a part of ultraviolet ray usage is entirely beyond the province of biophysical assay, and is even of questionable clinical efficacy.
2. Bactericidal action is abiotic.
3. Air cooled lamp.
4. Water cooled lamp.
5. American Journal of Electrotherapeutics and Radiology, p. 434, December, 1920.
6. Sherman's "Chemistry of Food and Nutrition."

EDITORIAL

The JOURNAL OF RADIOLOGY

A Journal of ideas and ideals.

Published monthly at Omaha, Nebraska, by the Radiological Publishing Company for The Radiological Society of North America.

Subscriptions—In the United States, its possessions and Mexico, $5.00 yearly; Canada, $5.50; elsewhere, $6.50 the year.

Advertising rates on application. All advertising must conform to American Medical Association Rules.

Payments for subscriptions and advertising must be made to Radiological Publishing Co., in New York or Chicago Exchange.

Address all communications to Business Office, 305 Arthur Building, Omaha, Nebraska.

ANNUAL MEETING

Hotel Statler, Detroit, Michigan

December 4, 5, 6, 7, 8, 1922

The December Meeting

THE FOLLOWING PAPERS have already been arranged for the annual meeting of the Radiological Society, which will be held at the Hotel Statler, Detroit, Michigan, December 4th to 8th, inclusive. There will be many more papers by prominent men throughout the United States and Canada. This list was on hand the first of October when the Journal went to press.

Judging from the correspondence which is being received relative to the meeting, there will be the largest attendance which the society has ever had. Having this in mind, it is suggested that those who expect to attend would do well to make hotel reservation at once.

CARL C. BIRKELO, M. D., Detroit, Mich.—Case Reports: (1) *Calcification of the Kidney with no History of Tubeculosis.* (2) *Calcification of the Visceral Pleura.* (3) *An Extensive Atrophic Arthritis in Both Feet.* (4) *Bilateral Calculi in the Fallopian Tubes.* (5) *Congenital Dislocation of the Hip Joint with Large Exostosis of the Neck of the Femur Extending Into the Acetabulum.*

ALBERT BACHEM, PH. D., Chicago, Ill.—*Comparison of Measurements of Intensity and Hardness of X-rays Produced by Different Types of American Transformers.*

KURT H. THOMA, D. M. D., Boston, Mass.—*Roentgen Diagnosis of Lesions of the Maxillary Bones.*

JOHN R. CAULK, M. D., St. Louis, Mo.—*The Relationship of Roentgenology to Urology.*

C. G. SUTHERLAND, M. D., Rochester, Minn.—*Radiography in the Examination of the Urinary Tract.*

JAMES S. PRITCHARD, M. D., Battle Creek, Mich.—*The Importance of Oblique Films in the Study of the Thorax.*

WM. L. ROSS, M. D., Omaha, Neb.—*The Therapeutic Uses of X-rays Other Than on Malignant Growths.*

L. R. SANTE, M. D., St. Louis, Mo.—*Lung Abscesses.*

WM. ENGLEBACH, M. D., St. Louis, Mo.—*Radiological Signs of Endocrine Disease.*

E. H. SKINNER, M. D., Kansas City, Mo.—*Roentgen Analysis of the Right Diaphragm in Health and Disease.*

PAUL EISEN, M. D., Detroit, Mich.—*Duodenal Regurgitation.*

A. U. DESJARDINS, M. D., Rochester, Minn.—*Mediastinal Lymphosarcoma and Hodgkin's Disease.*

H. T. PLANK, M. D., Chicago, Ill.—*Report of an Unusually Interesting Case.*

E. H. KESSLER, M. D., St. Louis, Mo.—*Diaphragmatic Hernia.*

KENNON DUNHAM, M. D., Cincinnati, Ohio—*Clinical and X-ray Findings in the Chests of Normal Children.*

MARY ELIZABETH HANKS, M. D.—*Remedial Effects of X-ray in a Gynecological Case.*

WM. J. CASSIDY, M. D., Detroit, Mich.—*The Importance and Necessity of Minimizing Diagnostic Errors by Repeated Roentgen Examinations.*

W. D. COOLIDGE, PH. D., Schenectady, N. Y.—*The Operation of High Voltage X-ray Tubes.*

R. D. CARMAN, M. D., Rochester, Minn.—*The Roentgenologic Signs of Cancer of the Colon.*

P. M. HICKEY, M. D., Detroit, Mich.—*Infections of the Sacro-iliac Joint.*

R. B. WILSEY, PH. D., Research Laboratory, Eastman Kodak Co., Rochester, N. Y.—*The Design of Potter-Bucky Diaphragm Grids.*

W. E. HART, M. D., Decatur, Ill.—*Congenital Partial Giant Growth.*

ISAAC GERBER, M. D., and F. NOLTON BIGELOW, M. D., Providence, R. I.—*Further Observations on the Use of the X-ray in Mastoid Diagnosis.*

AMEDEE GRANGER, M. D., New Orleans, La.—*A New Technique for the Positive Identification of the Sphenoid Sinus and the Ethmoid Cells.*

The Profession and The Public

IT REQUIRES neither stretch of imagination nor particular prescience, if one gives any thought to the question at all, to observe that there is a fundamental readjustment taking place in the relation of the medical profession to the public. Or stated perhaps more accurately, the public is forcing a different scheme of medical practice, hoping thereby to achieve more efficient and less expensive application of medical science.

For this reason it may prove of some advantage to attempt a visualization of this transformation—a transformation that is at once expressed by a comparison of the status of the old family doctor, whose memory is still distinct, with that of the highly specialized medical profession of the present day.

Starting from the proposition that the old family doctor covered every phase of medicine and surgery in his practice, and that today there are no less than twenty-five specialties, it may be possible, as well as profitable, to make some deductions from the comparison about to be undertaken, which will indicate at least a logical method by which the medical profession can accomplish the obligation which is impressed upon it as a factor in the social organism.

Not infrequently members of the medical profession make the declaration that the profession is neither the guardian of the public purse nor the custodian of public welfare. But such a position is untenable, in so far as the question of

health affects the earning power of the individuals constituting the public, and in so far as knowledge of causative factors of disease makes for greater health and happiness.

The family physician of yesteryear—the man of empty purse and overflowing heart—occupied a position which may well be described as family confidante. He stood on equal footing with the minister or priest, and to him each member of the family brought his or her intimacies and asked for advice. The family physician listened to the hopes and fears of the woman whose heart fluttered at the prospect of the first born; was present when the child came into the world, gave instructions about its care and feeding; attended it through the whole gamut of children's diseases from tummyache to diphtheria and back again; acted as the child's mentor in pubescence and adolescence; counseled it as it grew into young manhood or womanhood, and during courtship and marriage; and he attended that same individual in his or her last illness. For by the grace of the great gift which was in him the true family doctor was never permitted to admit exhaustion or failure, and, according to legend, possessed as he was of the key to the mystery of life, he never died until such time as he willed.

The point in all this is, that the family physician, as our forebears knew him, was their spiritual as well as physical and mental guardian. He was the sorcerer for whom men, women and children called when they fell in love, when they married, and when they died.

Once the family physician had become established in a community, he continued in that community as the friend of each family within its borders. So strong was the confidential bond between physician and patient that a new physician could not compete with him and could only acquire a footing in the community through the sanction of the family doctor. The frock coat, the long flowing beard, the silk hat, and the old kit complete the picture. The relation was so personal that to mention a fee was considered a sacrilege. The result was that the family physician died poor in worldly wealth but rich in clientele.

The practice of medicine today is very different. Now the patient consults a physician in much the same way in which he enters a department store as a customer. He chooses his doctor because of results obtained in some particular case about which he has heard, and lays his trouble before that physician in a businesslike manner. The service is rendered, the account is settled, and when the patient is in need of further medical advice he probably goes to an entirely different man, who he believes is more especially qualified to treat the ailment which he believes he possesses. One might almost say that the transaction is entirely devoid of any personal confidential relation.

This condition can readily be explained because of the change which has taken place in our community life. It is no longer possible for the physician to memorize the personal affairs of all of his patients. The community has grown entirely too large. And where the old family doctor looked at the tongue, took the temperature, counted the pulse, felt the abdomen, and with one ear against the chest listened to the heart and lungs, and from what he saw and heard made his diagnosis, the doctor of the present day must at his peril follow an entirely different procedure. To the credit of the old family physician it must be said that after a wide clinical experience he was able to obtain a high percentage of accuracy in his diagnoses, but it must also be remembered that he was of necessity an artist and not a scientist.

Nowadays, when a patient presents himself to a physician, he tells his story and a complete physical examination is made. This is followed by the various laboratory tests, urinalysis, blood count, blood Wassermann test, gastric analysis, stool examination, and x-ray examination. To carry out these details requires that the physician himself must spend hours or days on one patient or have assistants properly trained in the various specialties who can help him. Tersely, today more time is spent in arriving at a diagnosis than was spent under the old regime.

Interpreted in terms of money, diagnosis today costs infinitely more than the diagnosis of fifty years ago. Against the financial investment of the old family doctor, whose equipment comprised a small room, a desk, a table, two or three chairs, a thermometer, and a bag of instruments, and in the country at least, a horse and buggy, one is obliged to set up the cost of a suite of offices, laboratory equipment, x-ray equipment, automobile and various other appliances and apparatus. To this must also be added the cost of a stenographer or clerk, one or several nurses, and one or more assistants, depending upon the volume of business.

This change from the rendition of a purely personal service to the service of an organization involves an alteration of the doctor's viewpoint to correspond. It also involves a change in the viewpoint or the mental attitude of the patient who seeks what he thinks is the best service for the least money. That is, the average patient places the purchase of medical service on a commercial basis.

One of the outcroppings of this readjustment is seen in the frequent change of physicians by patients. The average patient is impatient, and if results are not obtained as quickly as he feels they should be, he seeks the services of some other physician about whom he has heard and who possesses the mysterious healing power attributed to the old family doctor.

The desire of physicians to meet this changed economic condition has induced too many to adopt means of publicity which are held unethical by the rank and file of the profession. No matter how sincere he may be in his purposes, whenever an individual physician attempts to educate the public on questions of health, those on the outside immediately assume that the compelling motive is one of personal aggrandizement.

No one questions seriously the need for greater knowledge by the public in matters of health. That being true, it would appear that the medical profession as an organization should find some way of communicating this knowledge to the public. Such an effort could not be criticised as a personal advertising campaign. The average member of the public is anxious to know more about questions of health and disease, so that he may govern his life accordingly. One of the best illustrations of this fact is the wide interest the public takes in the "Health Talk" columns carried by many daily papers. Another illustration is the extreme interest evinced by large audiences attending the public talks conducted by the Society for the Control of Cancer. These two concrete illustrations represent two methods which can be employed by the medical profession as an organization to promote better knowledge on the part of the public concerning medical questions, as they also indicate the need for organized and coordinated effort in this direction. The public press by and large is willing and ready to give space to medical problems of wide interest. As proof of this, attention is directed to articles lately published in the Atlantic Monthly, Century Magazine, Woman's Home Companion, Ladies' Home Journal, Hearst's International, and an announcement by the Survey that it has secured the services of Dr. Haven Emerson as associate editor in charge of a Department of Health and Preventive Medicine, which will be carried continuously.

There are other methods of reaching the public through the lyceum. Harvard University Medical School has conducted a series of lectures on medical subjects to which the public was invited. Attendance at these lectures has been far beyond expectation. Indeed, the interest has been so great that Harvard University is now publishing these

lectures as a series of monographs which will be placed on sale through the book stores. Each monograph is authoritative, is interesting and is written in language within the understanding of the average man.

Last winter the Mayo Clinic followed the same plan as Harvard University. A course of public lectures on medical subjects was given by members of the staff. One of the large churches in Rochester was obtained for the purpose and at each lecture the building was crowded.

The criticism may be offered that these methods are only practical for certain types of organizations such as large medical schools and groups. But this is not entirely true, for the medical society in each city, county or state furnishes a nucleus for a working organization representing the entire medical profession which can be called into service.

Where a medical organization sponsors such an undertaking, the personal element is eliminated. Material presented in this way is authoritative, and entirely devoid of appeal for any special line of therapy.

The Late Dr. Threlkeld-Edwards

ON September 30th last, Herbert Threlkeld-Edwards, of Bethlehem, Pa., died after a lingering illness of one and a half years. Dr. Edwards was personally known to a great many of the members of the Radiological Society of North America because of his active interest in the science of radiology, and his high professional attainments made him universally recognized as the stalwart and painstaking student whose labors added materially to the progress of radiology.

Dr. Edwards was born at Esher, Surrey, England, on March 30th, 1870. He studied under tutors in England, also attended Surrey House, and at the age of sixteen years accompanied his father, George Clayton Edwards, to this country.

He studied at the University of Southern California, then enrolled in the medical department of the University of Pennsylvania, and was graduated in the class of 1892.

After serving his internship at St. Luke's Hospital, Philadelphia, Dr. Edwards became demonstrator of pathology at the University of Pennsylvania, and remained as a member of the faculty for two years.

He then returned to Bethlehem, where he engaged in extensive professional endeavor for many years. Even under heavy professional demands, Dr. Edwards retained his habits of study and scientific research and developed the first American screen for intensifying x-rays. Of recent years he was actively engaged in the manufacture of this screen.

He devoted special effort to the study of roentgenology, in which he was a pioneer. Under his direction the modern x-ray laboratory at St. Luke's Hospital was founded and he was the first director there.

Dr. Edwards gave careful study to the advance of medicine and surgery during the great war, and he gave devotedly and prodigally of his time and labor to secure this advancement in hospitals and laboratories at home and abroad. His intensifying screen was widely used by the American Expeditionary Forces in France.

He was a member of the national, state and county medical associations, the American Roentgen Ray Society, the Philadelphia Roentgen Ray Society, the Philadelphia Medical Club, the Alpha Mu Pi Omega Medical Fraternity, the Country Club of Northampton County, and the Saucon Valley Country Club.

He is survived by his wife, his daughter, Mrs. Gerald Thorp, and his grand-daughter, Elizabeth T. Thorp, of Bethelehem, his son, Herbert Threlkeld-Edwards, Jr., of the University of Pennsylvania, and three brothers in Southern California.

Research at Coe College

ANNOUNCEMENT from Coe College is to the effect that a 200,000 volt deep therapy equipment has been installed in the department of physics in order that a definite program of research with respect to the physical laws underlying deep therapy may be carried on.

Dr. A. W. Erskine of Cedar Rapids will work in conjunction with the University. Professor L. D. Weld, in charge of the Department of Physics, assisted by Mr. Scott W. Smith, will direct the physical work. For the time being, it is stated that investigation will be confined to the subject of filters, but as rapidly as possible will be extended to include other phases.

Literature of Radium Therapy

USERS of radium will undoubtedly be interested in two books lately compiled by the American Institute of Medicine for the United States Radium Corporation. One is entitled "Bibliography on Radium," compiled under classified headings, with reference to the uses of and results obtained from radium since its discovery up to January, 1922. The other is headed "Abstracts of Selected Articles on Radium and Radium Therapy," and is very complete.

This is the first published effort that has come to our attention to put in the hands of the user of radium a complete compendium of past and current literature for ready reference on this subject. Compiled as these books have been by the American Institute of Medicine, they may be accepted as accurate and without any suggestion of commercialism. They constitute a very valuable addition to the radium therapist's library.

CASE REPORTS

More Than One Thousand Carpet Tacks in the Stomach

HOWARD CURL, A. B., M. D. and L. C. CULVER, A. B.
Madison, Wisconsin

A SEARCH of the literature will soon convince one that foreign bodies in the stomach and intestines are not rare. That there are many cases which are never reported is certain. A case seen recently by us, however, seems sufficiently out of the ordinary to merit a report.

A review of the literature seems unnecessary with this report as any one sufficiently interested may with little effort find as much as is desired. We found one case, however, of sufficient similarity to be mentioned briefly: Marshall [1] reports a case of a woman 41 years old. Two weeks after her fifth confinement she vomited blood. She then became unconscious for forty-eight hours. Her pupils dilated and her pulse was very weak. She recovered from this first attack, but was very feeble after a comparatively complete convalescence. Three years later she had a severe pain in the epigastrium and left groin. Upon examination a hard tumor mass was felt in the groin. It was about the size and shape of a placenta and it moved transversely when the patient shifted from side to side. Touching the body in this region produced vomiting although palpation was not painful. The patient also complained of pain in the shoulders and breast.

The menses were suppressed for three months. Constipation and continual vomiting (blood streaked) characterized the second attack. From this attack the patient apparently recovered except that the menses did not return. Five years later the vomiting returned and after three weeks the patient died. An autopsy showed the pyloric end of the stomach descended to the pubic. The pancreas was displaced. The duodenum was lying partly under the sigmoid colon. The cecum and colon were very small. There was no sign of peritonitis. The lower part of the stomach contained nine ounces of needles. The duodenum also contained a large number of needles, the total weight being over one pound.

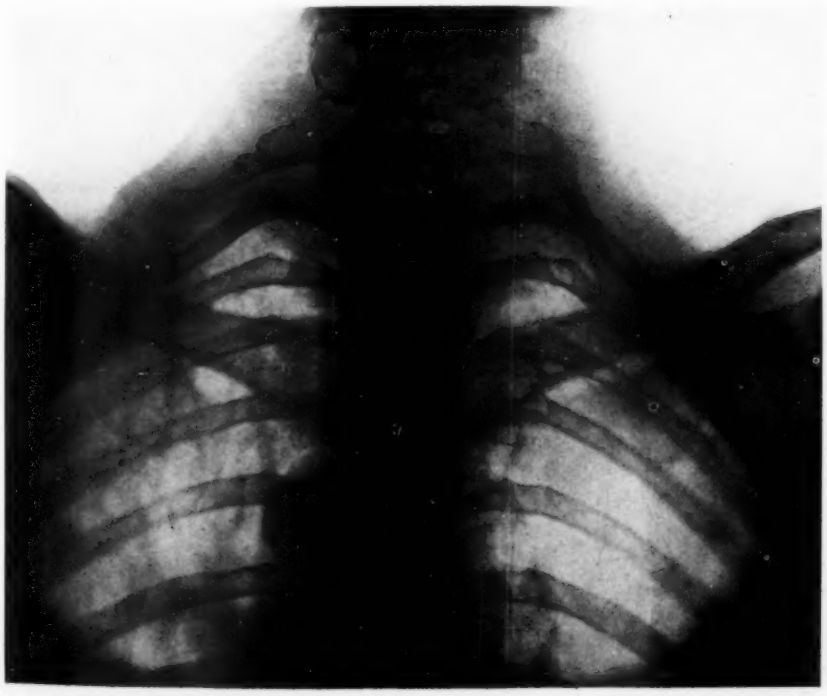
Thanks to the x-ray and modern surgery, our patient is still living although more than two pounds of carpet tacks were removed from her stomach. Her history which extends over a period of four years is as follows: Twenty years of age, weight 110 lbs., height 63 inches. Past history of no consequence and family history negative, except that the entire family, the patient included, were a little below the average mentally. Patient was a candy dipper by occupation. Early in 1918 she had an attack of appendicitis and was operated upon by a surgeon at Madison. Attention was first called to her mental condition following the operation, when through one of the welfare associations it was found that she had torn the freshly healed wound open and would not let it close. Through constant attention of a physician from the University Clinic, the wound was finally closed.

She was next heard from a year later, spring of 1919, when she appeared at the office of Drs. Joseph and J. P. Dean and asked to see Dr. Joseph Dean and told him that while crossing the street she had fallen and broken a milk bottle and that she thought some of it had gotten in her eye. When the doctor saw that th lower lid was full of small pieces o glass he knew that they had been put there, but this the patient denied. He removed the glass and treated the eye

Double Cervical Ribs

R. H. SANKEY, M. D.
Oxford, England

THE accompanying radiograph shows the presence of double cervical ribs, the one on the left being longer than the one on the right and having the appearance of a joint about the middle. This patient was a woman of fifty-five years.



and asked the patient to return the next day. This she did, but asked to see Dr. J. P., and to him she said that Dr. Joseph had removed some glass from her eye on the previous day, but that she thought there must still be come in the eye; there was, some twelve or fifteen small pieces. Two days later she appeared at the office of another physician with the same story and the same amount of glass. The glass was removed and the eye treated. This apparently satisfied her for the time being, for she was not heard of again until the following fall. In the fall of 1919 she was stricken with severe abdominal pains. She had some symptoms of intestinal obstruction and gave a history of not having had a bowel movement for four weeks. This, of course, we did not believe, but she was put in the University infirmary for observation. She was given a barium meal and examined. Stomach was apparently normal. There was a definite delay at the ileocecal junction. She was watched very carefully by the nurses, whose records showed that for eight days she had had no bowel movement. This was checked up by daily fluoroscopic examinations and at the end of eight days there was still barium in the terminal portion of ileum and the colon was filled. It was decided that she had obstructive adhesions about the cecum and Dr. Dean decided on a short-circuit (ileum to sigmoid colon) operation. This was done and the patient had an uneventful recovery.

Drs. Curl and Culver—Roentgenogram of patient, showing carpet tacks, etc. in stomach and intestinal tract.

Eighteen months later, April, 1921, the patient was taken with severe abdominal pains with vomiting. It was thought that perhaps adhesions had again formed nullifying the previous operation, and it was decided to give her a barium enema to determine if there was obstruction. The rectal tube was inserted and the enema started with the screen well down over lower abdomen. As the colon began to fill the screen was moved upward when we noticed a large dense dark mass occupying the region of the stomach. The enema was stopped. Upon close examination it was found that the mass seen was composed almost wholly of carpet tacks. The patient and her father refused to permit an operation. The case was brought to the attention of the Juvenile Court and an operation ordered. Drs. Dean performed a gastrotomy and removed from the stomach one thousand and forty carpet tacks, twelve screws, twelve safety pins, all of which were open, and many other small metalic pieces. The total contents weighed over two pounds. The patient had an uneventful recovery and has been perfectly well to date, almost a year and a half since operation.

BIBLIOGRAPHY

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Fracture of the Skull

FRANCIS B. SHELDON, M. D.
Fresno, California

CASE No. 2749. W. W. Negro, male, adult. Entered the hospital in a semi-conscious condition. At this time there were bruises about the face, the lips being badly swollen. There was no other external evidence of trauma.

Radiograms were made and the extensive fracture of the skull shown in the accompanying plates was found. The fracture line begins on the right near the occiput and extends forward across the frontal and back on the left to above the external auditory canal. On the right there is marked comminution and depression. Along the frontal there is considerable separation. There was a temperature of 101° F. the second day, after which temperature was normal. Patient rapidly gained consciousness and at no time complained of pain within the head. The extent of the fracture allowed it to give to any pressure and this probably accounted for the lack of pain.

Later history gives the cause of the fracture as a brick bat striking him in the face, the propelling force of which was the arm of his intended.

This case is reported because of the extent of the fracture, the manner of its occurrence, and the absence of the usual symptoms of skull fracture.

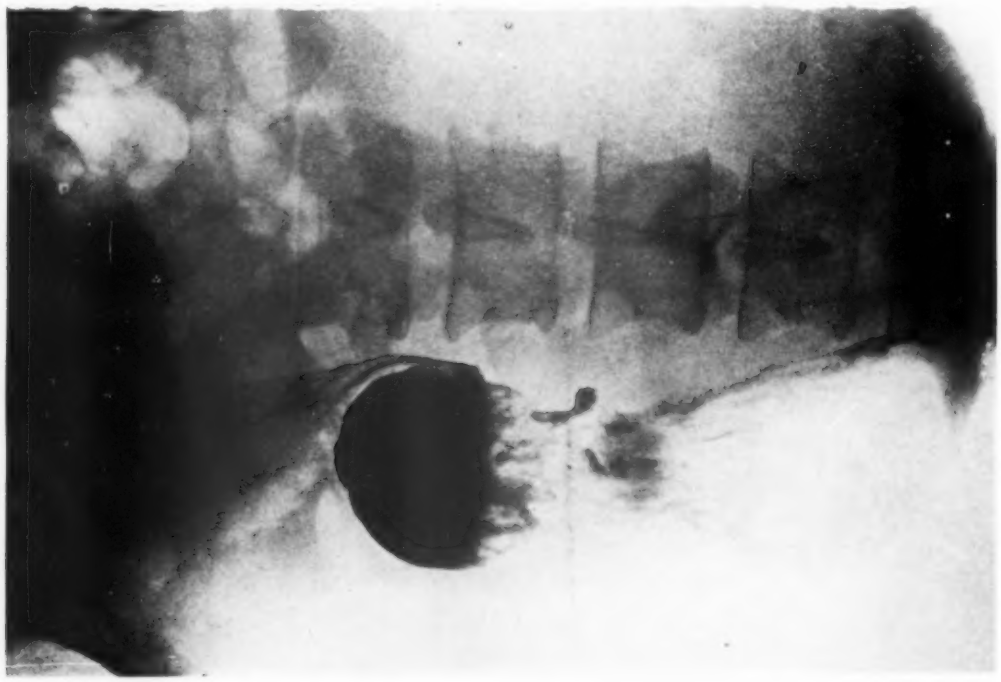
Figure I.—Right lateral, showing the extent of the fracture on both the right and left sides of the head, also the comminution on the right.

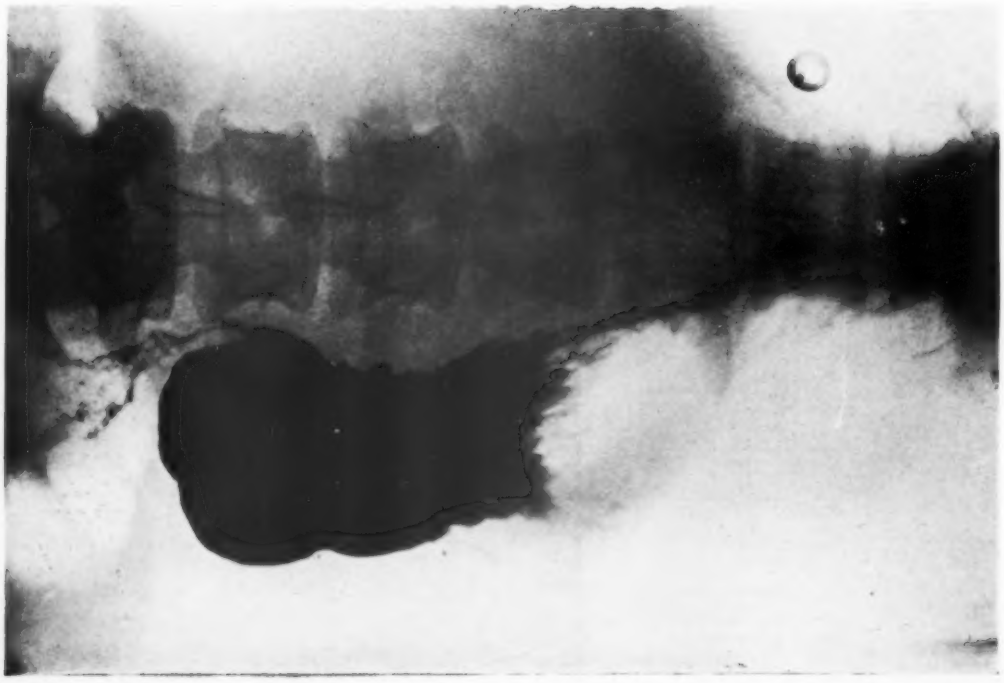
Figure II.—Postero-anterior view, showing the fracture line across the frontal and the depression on the right.

Hour Glass Stomach

J. M. W. MORRISON, M. D.
Manchester, England

THE following case is of interest because of the pathology shown and because of the apparatus used in making the plate. It will be noted from the accompanying illustration that we are dealing with an hour-glass stomach combined with an ulcer on the lesser curvature of the upper pocket. The patient is a woman of fifty-one years. The apparatus used for making this plate was installed in Ancoats Hospital, Manchester, England, in 1907. It was the first x-ray plant in Manchester and is still in use. The technique used for making this plate was a sixteen inch coil with a mercury gas break with exposure of one second, using duplitized film and intensifying screen.





DEPARTMENT of TECHNIQUE

Radiography of the Os Calcis

RAY A. WATTERS, B. S., A. M., Sc. D.
Emory University, Atlanta, Georgia

IT IS the purpose of this paper, in the following series of radiographic reproductions of the os calcis, to illustrate what seems the simplest, most reliable, and easiest method of securing x-ray plates of this particular part of the human anatomy. The necessity of a position has a great deal to do with its invention; but the necessity for securing a normal x-ray shadow should stimulate a certain amount of caution that the position will not be overestimated.

The x-ray plate should present a picture of such clearness and detail as to make the pathology easily seen. In other words, the picture presented to the roentgenologist should be normal in contour, which is of the utmost value in determining both the normal and the pathological structure. There are times when the technician finds radiography rather problematic from the standpoint of abnormal rather than normal shadows. A normal shadow is essentially the fundamental principle of all x-ray interpretation. It is absolutely impossible to secure a correct reading of plates that present abnormal shadows. There is but one way to overcome this error, and that is by establishing standard relations between the source of the rays, the sensitized plate, and the part subjected to examination. The operator must ever bear in mind that often even a slight deflection in the relative positions of the target, plate, and part being examined will result in some distortion which perhaps might render the plate of daubtful value and therefore useless from the standpoint of diagnosis. Experience has shown that the best results are obtained by closely adhering to standard positions; but it must be remembered that frequently these positions will have to be modified to meet the need of individual cases.

In presenting my position for the radiographic examination of the os calcis, I am not sure that it is entirely new. I have not, however, been able to find printed literature describing this position, and I have never observed its use in any of the many x-ray laboratories that I have visited. I am, therefore, forced to conclude that radiographic examination of the os calcis by this position is not generally known and at the present time is not in use.

The position most used at the present time for examination of the os calcis is that described in the "U. S. Army X-ray Manual" (see Fig. 2). This position is the standard position. The radiograph of the os calcis by standard position is secured by standing the patient on both feet. To illustrate: The right os calcis is to be examined. The right foot is placed on the plate, the left foot is placed firmly on the floor, approximately 24 inches in front of the right foot. The body is slightly bent forward, and the left knee is flexed anteriorly about 20 degrees. The right knee remains firm; the leg, however, is bent forward from the ankle (see Fig. 2). The target is run down within 20 inches of the plate; the tube is tilted to about 30 degrees. The central ray will enter over the tendon Achilles as shown by arrow in illustration. The result of this operation is shown in Figure 5.

The position herein submitted for your approval is less complex, and I believe more satisfactory than that of the now standard position. To illustrate: The patient, lying on his back, is made comfortable on the radiographic table. The right os calcis is to be examined. The right foot is slightly elevated by placing the heel on empty plate boxes as shown in Figure 1. The plate is placed directly under the heel, the posterior heel and tendon Achilles must rest firmly on the plate else the radiograph will be distorted. The foot is kept perpendicular to the plate. In a great many instances the patient is nervous and has a tendency to move the foot about, but this motion can be avoided by supporting the leg with sand bags. Two medium sized sand bags are sewed together by tape, which is of sufficient length to wrap around the phalanges and return to about five inches above the external malleolus. One sand bag is placed on either side of the foot, making a firm support for both foot and ankle. The target is drawn to about 19 inches distance from the plate; the tube is tilted 30 degrees toward the sole of the foot, making the point of entrance for the ray just above the heel (see Fig. 1). Results of this operation are shown in Figures 3 and 4.

It will be found that the technique is more easily acquired in the Watters' position. It has been the experience of the writer that in some x-ray laboratories it is next to impossible to make a radiograph of the os calcis by the standard position. If the patient is experiencing a great deal of pain, such as that from fracture, it is not advisable for him to stand. The standard position is more easily executed in laboratories provided with movable tube stands, but if the tube stand is mounted on the table the standard position is exceedingly difficult to execute. Usually a separate table must be provided for the patient to stand upon. Should the radiographic table be used for this purpose frequently the patient is too close to the high tension circuit.

In the Watters' position the discomforture of the patient is eliminated, and the mechanism may be manipulated

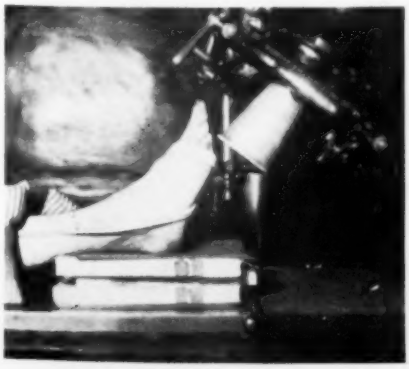


Fig. 1—Watters' position for x-ray of the os calcis.

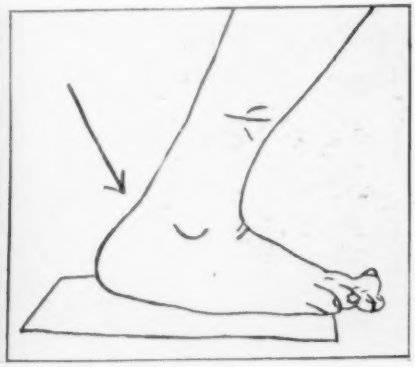


Fig 2—Standard position for x-ray of the os calcis.

with greater ease and accuracy (see Fig. 1). As to final results obtained in both the standard and Watters' positions little can be said. With careful technique a perfect plate may be had in either position. It will be remembered, however, that it is not advisable to dispense with the lateral view of the foot in cases of this nature. The lateral view is made with the target centered over first metatarsal.

CONCLUSIONS

1. The Watters' position is easier to acquire.
2. The patient is always comfortable.
3. The mechanism is more easily manipulated.
4. A correct and detailed shadow is obtained.
5. The results are as good, if not better, than those obtained by the standard position.

Fig. 3—Radiograph of os calcis, Watters' position.

Fig. 4—Radiograph of os calcis, showing fracture, Watter's position.

Fig. 5—Radiograph of os calcis, standard position.

Treatment of Ulcers Resulting from Radiation of the Cervix

R. C. FINLAY, M. D.
Greenville, Miss.

SLUGGISH ulcers of the cervix, which frequently follow application of radium are very difficult to heal and cause the patient considerable annoyance.

The treatment of these ulcers has not been altogether satisfactory. Recently, however, I have found that the application of a small amount of powdered iodoform directly to the ulcer has given me excellent results. I apply the iodoform powder on a paper trowel through a bivalve speculum, after which the vagina is packed with gauze. Ulcers treated in this manner heal much more quickly than any other method which I have tried and the odor is so scarcely noticeable that it is not objectionable to the patient.

Commercial Exhibit, Annual Meeting

From the interest already manifested, it is safe to assume that the commercial exhibit at the annual meeting of the Radiological Society of North America, to be held in Detroit, December 4th to 8th inclusive, at Hotel Statler, will surpass anything of its kind in the history of the organization.

With all the available space sold and manufacturers and distributors of various appliances and apparatus clamoring that they be given room to show their wares, there is no question but that the capacity of the hotel will be taxed to the limit.

In this connection, it is probably only fair to say that the attendance bids fair to outnumber anything previously of record in the science of radiology. A very comprehensive and instructive scientific program is being arranged, a scientific exhibit to which there has been nothing comparable in the history of the Radiological Society is assured, reduced railroad rates under the identification certificate plan will be in effect, and with the wide recognition that is being accorded radiant energy in its various forms both as a diagnostic aid and therapeutic agent, the meeting is sure to bring together an unusual number of men from all parts of the United States and Canada who are seriously interested in science.

The effort of the exhibitors will be to make their exhibits both interesting and educational. Each exhibit will be in the hands of competent men from whom information can be obtained without any embarrassment.

Exhibitors

Space No. 1—Patterson Screen Co., Towanda, Penn.

Space Nos. 2 and 3—Standard X-ray Co., 1932 N. Burling St., Chicago, Ill.

Space No. 4—Jno. V. Doehren Co., 208 N. Wabash Ave., Chicago, Ill.

Space No. 5—Radium Chemical Co., Marshall Field Annex, Chicago, Ill.

The Radium Chemical Company of Pittsburgh will have on exhibit the latest apparatus used in connection with radium work, and will demonstrate several new methods for handling radium. The present tendency is toward simplicity, and with that end in view, new instruments have been designed to simplify the handling and application of radium.

Following out the custom of having a radium conference in Pittsburgh either before or after all national meetings, we desire to announce that for this meeting the conference will be held from December 11th to 15th, and all members of the Radiological Society are cordially invited to be present.

Space Nos. 6 and 7—James Picker, Inc., 497 Lexington Ave., New York City, N. Y.

Space No. 8—Sagamore Chemical Co., Inc., 213-15 Water St., New York, N. Y.

Sagamore Chemical Co., Inc., New York, American distributors for "AGFA" x-ray films and plates, will have an elaborate exhibit, which is now being prepared abroad.

Space Nos 9, 10 and 11—Engeln Electric Co., 4601-11 Euclid Ave., Cleveland, Ohio.

Space Nos. 12 and 13—Victor X-ray Corp., 236 S. Robey St., Chicago, Ill.

Chief among the apparatus which will be on display will be the new Victor Stabilized Mobile X-ray Unit, a recent Victor achievement, which is radically different from any type of x-ray apparatus heretofore offered to the profession. The three most outstanding features of this new unit are the Stabilizer, Auto-Transformer Control and Circuit Breaker. The merits of the Stabilizer are already apparent to the majority of x-ray users throughout the country. Not only does this device eliminate the disadvantages due to line fluctuations, but it furthermore means a considerable saving in tube and film costs, not to mention the freedom from worry, and the certainty of results which will accrue to the user. The Auto Transformer control furnished with this new unit provides for twenty-six separate control steps, thus giving to the user a refinement of control that is truly ideal. The Circuit Breaker provided with this unit means not only protection to the tube, but also protection to the operator and patient.

Another Victor development which will be on exhibit is an improved type of stereoscope. This new outfit is the result of considerable experimental work by Victor engineers and combines features which make for a stereoscope of the utmost economy, simplicity of operation, beauty of design, and above all, even diffusion of light over the radiographs to be viewed, resulting naturally in more certainty in diagnosis.

The Victor line of Quartz Lamp Equipment will also be on display at the meeting. Both the Water Cooled and Air Cooled Lamps will undoubtedly attract the usual close attention on the part of the medical profession, but in addition there will be on display the new mobile hospital unit, which is designed so as to be conveniently wheeled from room to room.

Those in attendance at the meeting will also wish to carefully inspect the latest type of Victor High Frequency apparatus, a machine of portable construction delivering sufficient current for the treatment of any condition indicating the use of high frequency currents.

Space No. 14—Buck X-ograph Co., 6629 Olive St., Rd., St. Louis, Mo.

This exhibit will consist of a display of X-Ograph Dental Film Packets, X-Ograph Developing and Fixing Chemicals, the X-Ograph Contact Cassette, and X-Ograph Universal Dental Film Mounts, including a dental film mount filing device and film viewer, incorporating a decided departure from the old method of mounting and viewing dental radiographs.

Space No. 15—U. S. Radium Corp., 58 Pine St., New York City, N. Y.

In addition to a complete set of screens and applicators of most recent design, the United States Radium Corporation will show two books prepared for it by the American Institute of Medicine. One will be a complete bibliography of radium literature which has appeared in the medical press both in the United States and abroad since radium has been used therapeutically. This volume will enable a doctor to locate articles on any subject by any individual, as it gives name of publication, volume and date. It is designed to be a real index to the literature of radium therapy, and as such fills a long felt need.

The second volume is "Abstracts of Selected Articles on Radium and Radium Therapy," which includes approximately three hundred articles by leaders in this field. It is divided into thirteen sections and the articles are grouped as nearly as possible according to specialties, such as gynecology, dermatology, opthalmology and urology. The following quotation is taken from the foreword to the volume of abstracts:

> "In presenting to the medical profession this book of abstracts from articles on the medical use of radium, prepared for us by the American Institute of Medicine, we feel that we are repaying in part the innumerable courtesies and kind assistance given us by so many physicians all over the world. The work is a very thorough one and will, we trust, be of service to users of radium who seek a ready reference to some of the world's writings on this very important phase of therapeutics."

Dr. Victor F. Hess, head of the Physical Research Department of this company, has designed a small emanation plant for use of two hundred milligrams and more of radium. This plant has solved a number of the difficulties which have hitherto confronted emanation users and occupies a very small space. It can be operated by any physician or institution. After a thorough test it is now in active use in the hands of a radium therapist of very high standing. Pictures of this machine will be shown and a representative will explain any points of interest.

Space Nos. 16 and 17—Liebel Flarsheim Co., 410-16 Home St., Cincinnati, Ohio.

Space No. 18—Sweetbriar Laboratories, Inc., 1220-28 Hodgkiss St., N. S., Pittsburgh, Penn.

This exhibit promises something of unusual interest in the way of work done with the new Sweetbriar screens.

Space Nos. 19 and 20—Waite & Bartlett Mfg. Co., 53 Jackson Ave. Long Island City, N. Y.

OIL IMMERSED UNIT—This comes in a tank 23½ inches long, 12 inches wide, 13 inches high. Mounted in the tank is the high tension transformer and a separate filament current transformer. Above this is placed the lead glass shield and 30 milliampere radiator tube. The unit is shipped having the oil in a separate container. The tube goes in the regular crate. The tube holder, however, is arranged so that it is a very simple matter to put the tube in the lead glass shield and mount it in the tube holder, which is permanently attached to the under part of the cover.

There can be an opening in the top of the box for the x-rays to come through, or it can be placed on the side. It can also be arranged so as to take the same shutter that is used with our fluoroscope.

This unit can be mounted on a carriage under a fluoroscopic table, or it can be mounted between two uprights having a counter-balance adjustable for height.

NEW MODEL RADIOGRAPHIC AND FLUOROSCOPIC TRANSFORMER WITH OIL IMMERSED AUTOMATIC THROW HIGH TENSION SWITCH—This transformer is in a tank 16 inches long, 12 inches wide, 14 inches high. In this tank is mounted a high tension transformer, filament current transformer and double throw automatic high tension switch. There is a double set of high tension terminals coming out of the top. When this is connected with the control cabinet or control panel, the high tension switch is automatically thrown one way or the other, according to whichever foot switch the operator steps on. This does away with having to stop to turn the high tension switch or to even give it any thought. A still greater advantage is that it does away with the oxidation which takes place in the filament circuit of the ordinary exposed high tension switch, causing trouble.

NEW MODEL CONTROL CABINET FOR THIRTY MILLIAMPERE TRANSFORMER—The same equipment, instead of being in cabinet form, the cabinet mounted on a slate base so that it can be readily placed against the wall.

This control cabinet can be used either with the fluoroscopic transformer or with the oil immersed unit. The switchboard or cabinet, contains the following:

Coolidge meter, voltmeter and milliammeter.

Auto-transformer adjustable in two-volt steps.

Adjustable overload circuit breaker with double silver contacts opening both sides of the line.

Automatic current regulator which will keep the milliamperes constant at five or thirty. This is controlled by means of a two-way switch which is marked "Fluoroscopic and X-ray."

Two connections for floor switches to be used either singly or in combination with the fluoroscopic transformer, having an automatic high tension oil switch.

A plug connection for floor foot switch. This is arranged so that it is impossible to use 30 milliamperes except when the switch is on the side which enables you to use the foot time switch. In other words, you cannot possibly turn on 30 milliamperes with the ordinary foot switch.

There is another outlet which can be connected with a red light overhead so that when the foot switch is used the red light automatically goes out.

NEW MODEL G-U MASSACHUSETTS FLUOROSCOPIC AND BUCKY DIAPHRAGM TABLE—This consists of a table having the Bucky Diaphragm permanently attached to it and movable. At one end underneath is placed an oil immersed fluoroscopic unit which is adjustable six inches each way. Attached to the base of the Bucky is an upright which supports the oil immersed unit, arranged so that the rays come out of the bottom of the tank. This is accurately centered over the center of the Bucky so that after the operator has made a fluoroscopic examination, he can, without moving the patient, simply push the Bucky down to the other end of the table under the patient; the Bucky having been previously loaded wiht the film. The control board can be mounted at one end of the table if desired, so as to eliminate all wiring possible.

NEW AND ORIGINAL MODEL STEREOSCOPE—This is mounted on a counterbalanced stand so that the operator can sit down in a comfortable chair in front of it and make his examination without any discomfort.

The illuminating boxes are novel in construction, the curtains being placed inside of them but being adjustable from the outside. This enables the placing of a cross-bar so that the films can be readily held in position without any difficulty.

This apparatus stereoscopes very much easier than the ordinary type owing to the fact that the operator looks directly at one plate with one eye; while the other eye looks at the mirrored surface. It is hard to believe what a very great difference in clearness this arrangement results in.

UNITED STATES ARMY MOBILE UNIT—This is the model such as was made up for the U. S. Army in conjunction with the late Professor John S. Shearer of Cornell University, and represents the result of his experience in France. It has been designed with a view to economy of space without losing the advantages of universal adjustments.

This is in a cabinet 20 inches wide, 24 inches deep, 36 inches high. There is a 35 foot service reel permanently attached in the cabinet to be connected with the electric light service. There is space so that a rotary converter can be used to operate up to ten milliamperes, and mounted in

this unit. The sides are all removable, so that every part is accessible.

This is a unit which every hospital should have. It will do all kinds of radiographic and fluoroscopic work. It is, of course, not suited for therapy or for instantaneous work; but it will answer the requirements of any small hospital.

LATEST IMPROVEMENT ON 10 K. W. INTERRUPTERLESS MACHINE FOR ALTERNATING CURRENT—This 10 K. W. Interrupterless Machine has been improved in the following ways:

All makes of alternating current interrupterless machines have polarity indicators; so that when the apparatus is put into operation the operator is supposed to look at the polarity indicator and then turn the pole changer switch one way or the other. If, however, he fails to do this and closes the operating switch, the polarity may be wrong and the possibilities of puncturing a tube are very great.

With this new arrangement, this is all absolutely avoided. It is simply impossible to turn on any high tension unless the polarity is correct. When the machine is started up there is a red light. If this lamp lights up the polarity is wrong. If, however, the operator neglects to pay any attention to it and goes ahead and closes the operating switch, nothing will happen, he simply cannot get any high tension. He will then, of course, look to see what is the matter and notice the red light, which means that the pole changer should be turned in the opposite direction. This device is exceedingly simple and there is nothing whatever to get out of order.

This unit also carries an auxiliary contact. This is for use in making automatic stereoscopic exposures in combination with the new electric-trip stereoscopic tubestand and electric-trip vertical plate changer. In order to do stereoscopic work with the new equipment, it is simply necessary to load the plate changer, place the patient in position, and have the tube in position for the first exposure. The operator then simply closes the operating switch. This will make the first exposure, and the instant it is over the tube will shift and the plate changer will revolve. During this period the time switch will reset itself; and the instant the second plate comes into position the second exposure will be made and cut off.

Space No. 21—French Screen Co., 406 McKerchey Bldg., Detroit, Mich.

Space Nos. 22, 23 and 24—Kelley-Koett Mfg. Co., Inc., Covington, Ky.

Space Nos. 25 and 26—Radium Co. of Colo., Radium Bldg., Denver, Colo.

The Radium Company of Colorado will exhibit a complete line of radium applicators and accessories. In addition to the usual instruments which have been regularly furnished with radium, the equipment shown will include numerous accessories of new designs.

The gold needle with platinum-irridium tip has been discontinued and needles of platinum-irridium or non-corrosive steel, are recommended. Possibly the most interesting development in needle design will be the new short length non-corrosive steel needles containing five milligrams each. These needle applicators, which are exactly one-half the length of the ten milligram needles and identical in external diameter, will be shown with accessories to facilitate application. The advantage in using the short needles of this design in conjunction with the standard long ten milligram needles will be demonstrated, with reference to the adaptability of standard screens.

A slender needle designed to contain three or five milligrams of radium element will also be included. Platinum-iridium needles of sufficient wall thickness to absorb all Beta radiation will illustrate the prevailing tendency in French design of such radium applicators. Brass capsule screens to contain needles have recently been added to the equipment not shown in the company's catalog.

Among new accessories for needles is a new type of needle introducer which has practically eliminated every difficulty in threading. The instrument is designed for imbedding non-corrosive steel needles. It will be shown in six, eight, ten and twelve inch lengths.

Another needle accessory is the flexible needle-holder, designed for use in conjunction with some standard form of operating cystoscope. This special needle introducer is supplied to meet a demand for a simple attachment for any standard instrument to avoid the necessity of duplicating the expensive lens system and other parts of the entire cystoscope. As an operating cystoscope is invariably found in the urologist's armamentarium, the new accessory will probably meet with general approval.

The result of considerable study and co-ordination of ideas obtained from numerous radium therapists will be seen in a new form of esophageal applicator. The chief advantage claimed is the simplicity of design. The instrument will be shown in various sizes to contain either glass radium-containing tubes or metal needles.

A new form of metal lined carrying case for radium needles will be shown. This case has been designed to accommodate the wires attached to needles, thereby providing a satisfactory container to hold the needles when ready for application. The number of needle compartments is made to meet individual requirements.

Metal-covered plaques in the design of which a marked departure from existing practice has been made, will be shown with records to illustrate the advantage of the new instrument over the older form of composition-covered plaques. The radium in the new flat applicator is distributed directly beneath a very thin layer of Monel metal, which permits the passage of approximately three times as much beta radiation as escaped through the much thicker layer of composition. These plaques are shipped in new lead-lined carrying cases which will also be included in the equipment shown at the Radium Company of Colorado booths.

Adaptable applicators have been designed to facilitate the application of glass tubes or metal needles in the treatment of skin conditions. Several types of these instruments will be shown, including applicators to hold two glass tubes in separate compartments, and instruments to contain five or more needles. In each instrument the primary applicator is held in position beneath a very thin layer of non-corrosive steel.

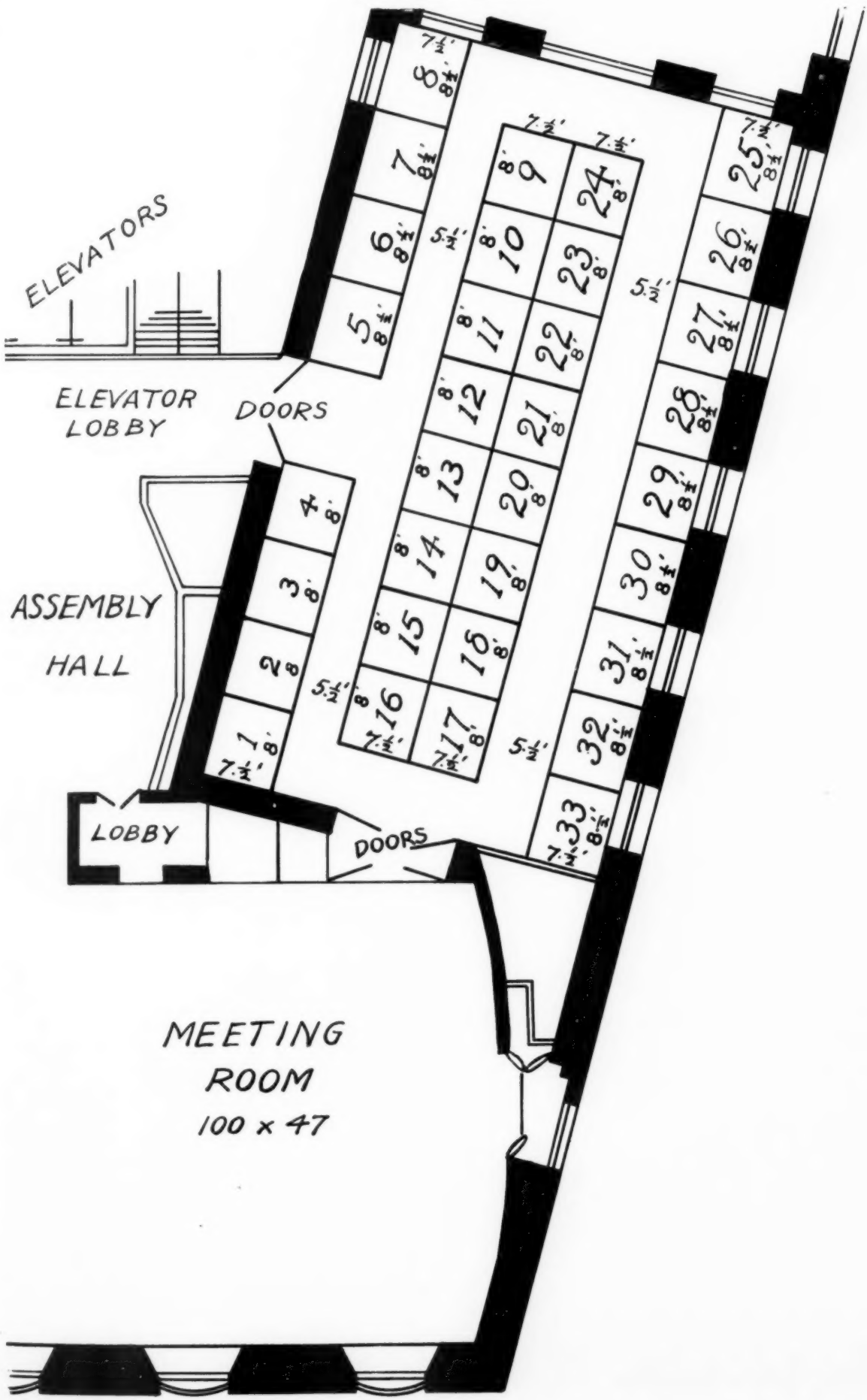
Several forms of very practical distance applicators will be shown, including a special form of eye cup to hold radium tubes or needles at a distance of approximately twenty-five millimeters. The distance applicators and eye cup are supplied with special sheet-metal screens of various thicknesses. A convenient screen of gold-plated brass, moulded to fit the contour of the eye may also be mentioned.

Among the general accessories will be included, Balsa wood for blocking radium away from the skin. It is an extremely light weight wood, highly recommended on account of the ease with which it may be cut to the required shape and also because it absorbs very little gamma radiation. A special grade of Kerr's Dental Compound, Bronze Ligature Wire for radium needles, sheet-lead in various thicknesses and special forms of pure rubber tubing will also be exhibited.

The above mentioned articles are some of the new accessories which, together with the other instruments that the company has regularly furnished its clients, will be demonstrated by representatives, who will be in attendance at booths twenty-five and twenty-six during the entire session of the Radiological Society meeting.

Space Nos. 27, 28 and 29—Acme X-ray Co., 341-51 W. Chicago Ave., Chicago, Ill.

Space Nos. 30, 31, 32 and 33—Wappler Electric Co., 162-84 Harris Ave., Long Island City, N. Y.


ELEVATORS
ELEVATOR LOBBY
DOORS
ASSEMBLY HALL
LOBBY
DOORS
MEETING ROOM
100 x 47

ABSTRACTS and REVIEWS

The Radiological Clinic of the Philadelphia General Hospital. Joseph C. Doane, M. D., Mod. Hosp., 19:213, September, 1922.

PHILADELPHIA has the honor of being the first city in this country to purchase radium for the treatment of neoplastic disease in a municipal hospital.

The staff of this radiological clinic consists of a dermatologist, surgeon, urologist, gynecologist, radiologist, laryngologist, oral surgeon, internist, pathologist, physician, and senior assistant medical officer.

The staff with all its assistants holds a regular staff meeting weekly. Each chief has a designated hour for conducting his clinic when all treatments are given and return cases examined.

Two visiting physicians are in general charge, one in charge of diagnostic work and one in charge of therapy. A full time radiologist with his assistant follows up the treatment and supervises dressings. He is responsible for placing and removing all applications.

A graduate nurse is in charge of the clinic and there is also one on each ward with as many pupil nurses as the occasion may call for.

Eighty hospital beds are provided in the hospital proper and in addition there are two four-bed wards located in the clinic suite for the use of ambulant patients.

The clinic is equipped with a high voltage machine having a twenty-inch spark gap. Two grams of radium have been purchased for therapeutic use. The physical laboratory consists of an emanation room, a technical tool shop for constructing apparatus and instruments for use in radium treatments, a measuring room and a preparation room.

A physicist, a technician and a glass blower are employed in the transfer of pure emanation from the radium solution in the laboratories.

The cooperation of all members of the medical profession is sought in order that cases shall be early referred for treatment. Benign as well as malignant growths are referred to the clinic. The electrothermic method of coagulation is used for removal of sloughs in advanced cases of malignancy.

Six research problems have already been started with the cooperation of the radiological department, and a radiological library located in the radiological research room of the laboratory is being collected to facilitate research work.

The Value of Radium in Gynecology. John A. McGlinn, M. S., M. D., F. A. C. S., Therap. Gaz., 46: 609, September 15, 1922.

THE EVILS of over-enthusiasm upon the subject of radium therapy are first commented upon by this author, but he adds: "Negative harm will also result from the failure of the skeptic to use it in cases when it is distinctly of greater value than surgery. Equally bad results are apt to obtain from the use of radium by the surgeon who knows pelvic pathology and diagnosis, but nothing of radium technique, as by the radiologist who knows radium technique, but nothing of pelvic pathology and diagnosis."

A trained radiologist working with a trained gynecologist is the ideal procedure, but when this is out of the question then each specialist must perfect his knowledge of the other specialty if he is to do his duty by his patients.

Radium banks, if properly controlled, serve a very useful purpose, but if they rent radium indiscriminately to the competent and the incompetent radiologist alike they are a menace to the public.

"In general radium has proved of distinct value in the treatment of malignant disease of the pelvic structures, uterine fibromata, uterine hemorrhage, leukorrhea."

In regard to malignancy he says: "Radium in a true sense is not a competitor of surgery; it is simply a most valuable addition to our armamentarium in the treatment of inoperable, gynecological cancer." In late cases there is nothing which gives such brilliant results as radium. Experience alone can decide whether radium should supplant surgery in operable cancer of the cervix; time enough has not elapsed as yet to make positive and conclusive statements with regard to this. The author at present uses radium in the growth and follows this with radical hysterectomy. He believes that radium will eventually supplant surgery, but the time is not yet.

In cancer of the body of the uterus surgery is the method of choice. In that of the vagina and vulva radium and x-ray therapy are the preferable forms of treatment.

X-rays and radium will cure fibroid tumors of the uterus in properly selected cases, but this is a very important qualification. In general, radium should not be used in infected tumors or in those with infected adnexa; in necrotic tumors; in those associated with malignant disease of the body of the uterus or diagnosed malignant changes of the tumor itself if still operable; in young women if avoidable by surgery; in stony hard tumors; in very large tumors or those causing distressing or dangerous pressure symptoms.

In uterine hemorrhage "radium is a sure and prompt hemostatic for all uterine bleeding not due to cancer, fibromata, other neoplasms, retained secundi, or periuterine inflammations. * * * In the myopathic and endocrine bleeding in younger women it should be used only after other measures have failed to effect a cure."

In cases of cervical leukorrhea radium in small dosages is useful, but the age of the patient is here a factor as in the lesions discussed above.

"Radium is the greatest addition to gynecic therapy in a generation. Used when indicated in the proper manner it is a wonderful servant; when enthusiasm for its use warps judgment it is a bad master."

Roentgen Treatment of Carcinoma of the Portio Vaginalis. Dr. Martius, Bonn. Deutsche med. Wchnschr, 48:977, July 21, 1922.

A CASE of inoperable carcinoma is here reported. The patient, 59 years of age, had a very large tumor extending a finger length back of the introitus vaginae and there was a spreading infiltration of the pelvic wall of at least the thickness of the thumb.

This case was treated with both radium and roentgen rays. Forty-five milligrams of radium element with one and one-half millimeters of brass filter were used. The exact location of the tumor underneath the skin was determined by the aid of a specialized form of compass with curving ends. If the extreme point of one leg of the compass is brought to rest over the intravaginal growth the other end will, upon closing the compass as far as the body surface permits, rest upon the skin just above the growth and the distance is then calculated by mathematical formula. Not more than five fields are used and these are located upon the abdomen, the back, the gluteal region and that of the vulva. The dose must be so calculated that when it reaches

the tumor it will have the same intensity as an erythema dose has at the surface.

Treatment of this patient had been begun six months before the presentation of this paper and at the time of presentation she was clinically cured and had gained eleven pounds in weight.

Many physicians take the attitude that roentgen treatment of inoperable cases of carcinoma of the uterus is not worth while. The author believes that not only is treatment in these cases decidedly worth while, but that the physician who fails to advise this treatment is not doing his duty.

Roentgen Ray Therapy in Disturbances Due to the Menopause. Franz Groedel, M. D., Frankfurt. Muenchen. med. Wchnschr., 69:423, March 24, 1922.

DISTURBING symptoms often persisting for years after cessation of the menopause, and often leading to mistaken diagnoses, are an unnecessary drain upon the patient's health and general well being.

The author of this article believes that these symptoms are largely due to functional derangement of the glands of inner secretion, especially of the ovary, and he cites a number of observations in support of this theory.

Roentgenotherapy of these cases is advocated by the author and has yielded good results in his practice. Stimulating doses of the rays are given the ovaries.

Roentgenotherapy of Tumors of the Hypophysis and of Gynecological Lesions of Hypophyseal Origin. Dr. Blumberg, Berlin. Muenchen. med. Wchnschr., 69:739, May 19, 1922.

THE HORMONE theory of therapeutics, although only in its infancy, is exerting considerable influence.

Raying the pituitary body was first practiced by Gramegna and Beclere and later by Gunselt and Kueppferle. Szilly, Darier, Fleischer and Juengling, as well as Schaefer and Chotzen, used this form of treatment for tumors of the hypophysis, and for gigantism and acromegaly. Lately (1921) Fraenkel and Geller in treating certain gynecological disorders have made use of this same method because experimental and clinical studies have led them to the conclusion that certain of these disorders have their origin in a disturbed function of the hypophysis.

The author has used the method with good results in several cases (one of tumor and three of dysmenorrhea) and believes that the method will continue to prove of value.

End-Results of Operations for Cancer of the Breast. Frank E. Bunts, M. D., Ann. Surg. 76:341, September, 1922.

END-RESULTS gathered from the available records of his own cases, which number 600, are the basis for the conclusions reached by this author.

He states that type of cancer, age and hereditary predisposition of the patient all influence the results in any series of cases and that unless statistics are grouped with these factors in mind they are of little value in arriving at conclusions as to end-results.

His conclusions are: "(1) The successful treatment of cancer of the breast as of any other condition should be strictly individualized. (2) The ultimate sequelae depend more upon the stage and dissemination of the growth when it is presented for treatment than upon any defined method of operation. (3) Greatly increased data regarding the value of pre and postoperative use of the x-ray and of radium are required before final conclusions can be drawn, although there seems to be little doubt of the value of radium applied directly in the axilla. (4) The substitution of the x-rays or of radium for surgical treatment cannot safely be considered at the present time. (5) The early removal of any growth remains the one and only sure method of treatment."

He states that in his earlier cases he gave postoperative x-ray treatments as a routine procedure, but later discontinued them because there seemed to be unusually rapid recurrences in many cases so treated. "With the establishment of more certain methods for measuring the dosage, we have tentatively resumed the use of the x-ray and are carefully watching the results. The use of deep x-ray therapy in the treatment of cancers of the breast to the exclusion of operation opens a hopeful, but thus far non-productive, field of speculation."

Results of the Treatment by Radiation of Primary Inoperable Carcinoma of the Breast. Burton J. Lee, M. D., Ann. Surg., 76:359, September, 1922.

A BREAST clinic was established in Memorial Hospital, New York City, in the fall of 1919, and a systematic effort has since then been made at this institution to study the whole problem of carcinoma of the breast.

All patients included in this present report have been admitted during the years 1918-1920. The last case began treatment sixteen months ago.

A primary inoperable carcinoma of the breast is defined as one in which appears one or more of the following factors: Fixation of the breast tumor to the chest wall; involvement of the supraclavicular nodes; definite involvement of the opposite axillary nodes; diffuse subcutaneous nodlues; diffuse inflammatory carcinoma involving a considerable skin area; chest metastases—pleural or mediastinal; more remote metastases. "All surgeons will not, perhaps, be in accord with these indications of inoperability."

The rate of growth of these primary inoperable carcinomas can be considerably checked with consequent regression and sometimes disappearance, while involved nodes in the axillary or supraclavvicular regions will likewise often regress and often disappear. A fixed breast tumor may be rendered mobile and thereby operable, so eliminating subsequent ulcer. Relief of pain in some measure, sometimes very marked relief over a, considerable period, follows radium.

The author's technique for radium and for roentgen treatment is given in the original paper.

In his general conclusions, besides the points already mentioned above, he includes the following ones: "The patient must be kept under constant clinical observation. The type of radiation must be properly selected for each individual case; no routine prescription will suffice. Overtreatment by radiation must be avoided. Very advanced cases are unsuitable for any form of treatment. The palliative operation following properly planned radiation is of service in well selected cases. A cooperating social service department makes a follow-up system effective and gives humanitarian relief to the hopeless cases. The results to date are very gratifying and encouraging. As the disease itself and the technique of radiation becomes better understood, we believe that more and more satisfactory results will follow and that the possibility of the still further control of the disease by radiation may ultimately be realized."

Disturbances in Mammalian Development Produced by Radium Emanation. Halsey J. Bagg, M. D., Am. J. Anat. 30:133, Jan. 5, 1922.

A DEFINITE quantity of common salt was exposed to a comparatively large amount of radium emanation, and to the radio-active salt thus obtained sufficient water was added to make a physiological solution. Pregnant rats were injected subcutaneously in the shoulder region and intravenously through the caudal vein with three to four minims of this solution which ex-

hibited all the known phenomena of radium metal; alpha, beta, and gamma rays were present, the alpha rays producing the greatest physiological effects, it is thought. Five millicuries was found to be the maximum amount applicable for the aims of this experiment.

In a second method gamma ray radiation was applied through the ventral wall of pregnant rats at nearly full term. An amount of emanation was used equivalent to one and one-half grams of radium metal, filtered by two millimeters of lead and one-half millimeter of silver, the source of emanation being one centimeter away from the animal. A dose of 1300 mc. hours produced developmental arrests in the embryos, but did not kill the pregnant animals. Doses as high as 2900 mc. hours were successfully used in some cases. Embryos were killed by ether, and histological material was secured at various periods after treatment. Tissues were fixed in Bouin's solution and stained with hematoxylin and eosin.

The report of this study covers 18 pages of text. The author's conclusions are:

"1. The marked selective action of radium emanation on fast growing embryonic structures was noted in these experiments.

"2. Very decided developmental arrests occurred in the differentiation of the nervous and reproductive systems of mammalian embryos exposed to radiation toward the end of pregnancy.

"3. Experimental animals with greatly reduced, or practically no neopallium, gave apparently normal neurological behavior, except for blindness.

"4. Radium emanation used either in the form of a radio-active solution injected into the adult female, or employed as an external gamma ray radiation, produced marked areas of extravasation in the subcutaneous connective tissue of the developing young. This suggests that the action of radium emanation might be selective upon the endothelium of blood vessels.

"5. Extravasations occurred in the developing young of females treated with radio-active solutions a considerable time before fertilization, and suggests that in some way the faculty of the later developing embryos to form proper blood vascular endothelium had been interfered with.

"6. The results so far obtained indicate that gamma ray radiation is a physical agent admirably adapted to the study of experimentally produced developmental arrests in mammalian embryos.

"7. When women are subjected to therapeutic irradiation, especially during the early stages of pregnancy, the clinician should be forewarned concerning the possibility of producing very grave disturbances in the developing child."

Some Effects of Radium Emanations on White Mice. Drs. Kanematsu Sugiura *and* Gioacchina Failla, J. General Physiol., 4:423, March 20, 1922.

MICE were exposed to radium rays soon after birth and during the period of rapid growth. Control experiments were carried out under identical external conditions upon animals as nearly as possible like the radiated ones.

The radium emanation, mostly beta rays, was inclosed in glass tubes which rested upon a very thin sheet of mica rigidly suspended at a distance of two centimeters over the animal, which lay on a cavity covered by another very thin sheet of mica. Exposure was over the central dorsal region or over the head, for five minutes in every case.

A dose of 2.4 mc. hours, fractionally applied for a period of eight weeks, accelerated the growth; the weight of the irradiated mice exceeded considerably that of the controls until the twenty-seventh week, when weights of the two groups became about the same.

A dose of 11.5 mc. hours had no effect on body weight, but caused the eyes of the new born mice to open from 12 to 24 hours earlier than did those of the controls. A dose of 29.9 mc. hours markedly decreased the growth until about the forty-fifth week, when the average weight of the radiated mice became about the same as the controls.

A dose of 31.6 mc. hours resulted in death the twelfth day; one of 36.5 mc. hours resulted in death the ninth day.

A dose of 2.4 mc. hours, though producing no visible skin changes, rendered female mice permanently sterile. The males, owing to the fact that under the conditions of these experiments the reproductive organs were farther situated from the source of radiation and better protected by intervening tissues than was the case with the females, were not rendered sterile even temporarily by any dose, even one close to the lethal dose.

The Effects of Radium Rays on Metabolism and Growth in Seeds. Alfred C. Redfield *and* Elizabeth M. Bright, Laboratory of Physiology, Harvard Medical School, J. General Physiol., 4:297, Jan. 20, 1922.

RADIATION of radish seeds with beta and gamma rays showed that while germination was delayed and sometimes prevented entirely, the seeds were not killed. This latter fact was proved by their undiminished production of carbon dioxide.

The observation is made that "Changes in the rates of carbon dioxide production and cell division do not always go hand in hand; one may be increased by exposures which retard the others. * * * Malformations of embryos must be due to an unequal effect on various processes which go on side by side. If all processes were affected alike their courses might be run more rapidly or more slowly, but at any instant the conditions of equilibrium in the tissue would not be abnormal. It is the specific action of radiations on certain physiological processes in contrast to others which accounts for the characteristics of their effects. * * * Consequently, it is unjustifiable to make any general assumption concerning their action on the chemical changes of living matter as a whole."

Action of Beta Rays of Radium on Excitability and Conduction in the Nerve Trunk. Drs. E. S. *and* A. C. Redfield *and* A. Forbes, Am. J. Physiol., 59:203, February, 1922.

THIS is a study of the effects of excitability and conduction produced by exposing the nerve trunk only (of the frog) to radiation. Controls were used throughout. The source of the radiation was radium emanation in amounts from 12 to 180 mc., according to the experiment under way. The emanation was inclosed in glass tubes approximately 1 mm. in diameter and 7 to 15 mm. in length; consequently the effects were due to the beta and gamma rays, the former predominating.

Very intense radiation with beta rays, it was concluded from these experiments, destroys the functional capacity of a nerve trunk. It is interesting to note that cells in mitotic division are supposed to be especially sensitive to radiation and that of all tissues the nerve tissues are perhaps the farthest removed from the capacity of mitosis.

It was further concluded (2) that in the nerve trunk "there may be a marked latent period between the termination of radiation and the loss of function * * (3) The disturbance of function is one which involves both conduction and excitability * * * in the early stages at least, conduction occurs with a decrement so that an impulse set up in the middle of the improvised region will be conducted through the remainder of it, while one set up outside of this region will fail to pass through the whole of it. * * * Effects on excitability are shown when the stimulation is applied in the radiated region. In several experiments with an intensity of radiation so moderate as to produce the disturbance very gradually,

a slight increase in excitability was found, followed by a fall. In the majority of cases, especially in those in which the radiation was more intense, the first and only effect of the rays was to decrease excitability and this decrease usually occurred before conduction had been so far impaired as to establish a complete block to any impulse set up proximal to the radiated region. (5) Correlated to the loss of function of the nerve trunk is a stiffening of the tissue, and this appears to be more marked the greater the radiation. Microscopic examination reveals fatty degeration of the myelin sheath."

Factors Which Determine the Concentration of Calcium and of Inorganic Phosphorus in the Blood Serum of Rats, Dr. Benj. Kramer *and* John Howland. Bull. Johns Hopkins Hosp., 33:313, September, 1922.

"THE concentration of neither element has been distinctly increased beyond normal limits, either as the result of various additions to the diet or the use of physical agents. It seems fair to assume that this cannot be done by either of these methods. On the other hand, it is possible to reduce the concentration of these elements in the serum by feeding diets containing an insufficient quantity of the respective elements."

It was found that starvation, the addition of phosphorus to the diet in organic or inorganic form, the addition of fat to the diet, or exposure to radiations from various sources yielding wave lengths of less than 3000 Aengstrom units will increase the serum phosphorus to a marked degree.

Blood Change in Myelogenous Leukemia Following Radium Treatment. B. R. Whitcher, M. D., Bost. M. & S. J., 187:350, September, 1922.

LEUKEMIA, its history, pathology and treatment is discussed in this paper and a case report is given.

Judicious and persistent use of x-ray or radium has been shown to have a markedly beneficial effect on the patient's health. Medication by benzol is also of benefit but the effect is not so marked as that following radium or x-ray.

Gilbert, Paris, reports that the cure by these agents is not ordinarily permanent and that the effects progressively decrease after the first "cure." Peabody reports practically to the same effect, as does also Gulland, who adds that radium treatment is preferable to x-ray because benefit from it is more quickly apparent and more certain than from x-rays. Metcalf regards radium treatment as excellent for this disease, but believes the doses must be massive and frequent, otherwise abnormal activity is stimulated.

In summing up his observations, particularly those upon the case reported, the author says: "The observations show, on the one hand, that the application of radium in myelogenous leukemia does produce an apparently beneficial effect on the patient, if the amount of radium applied is regulated with caution, as the leukocyte count is reduced to nearly its normal level, the myelocytes are greatly decreased, and at times made to disappear altogether, the blood is brought to a more nearly normal appearance, and an apparent general improvement takes place in the patient's clinical condition. But the treatment needs to be given at regular intervals. On the other hand, the study of this case indicates that radium is a factor frought with danger, and that caution is necessary in regulating the amount to be applied, lest an excessive amount of radium or too frequent application may cause undue destruction of the leukocytes, and so injure the reproductive powers of the bone marrow that a rapid leukopenia and anemia result.

"While Mr. Metcalf in his treatment of myelogenous leukemia with radium has applied it over the sternum and epiphyses of the femora, and humeri, as well as over the enlarged spleen, it has been deemed of late, here at the Post-Graduate Hospital, to be a better procedure to apply the radium over the enlarged spleen only, and the lymph nodes, if enlarged, but to let the bone marrow alone, until the myelocytes have entirely disappeared from the blood. There appears to be danger that in treating the bone marrow at the same time, its power to produce new red cells may be weakened so that the red cells and hemoglobin decrease along with the leukocytes. However, much more experience will be required to ascertain exactly the effect to be expected and the best mode of applying radium therapy in this disease."

Hits and Misses in the Diagnosis of Skin Eruptions. C. Piper, M. D., Johannesburg, South African Med. Rec., 20:268, July 22, 1922.

IN A DISCUSSION of psoriasis the author cautions against the administration of arsenic subsequently to x-ray treatment, since, even months after treatment, it may excite a very marked erythema.

A Criticism of Recent Interpretations of Annular Shadows in Lung Roentgenograms. M. P. Burnham, M. D., *and* Philip King Brown, M. D., Am. Rev. Tuberc., 6:469, August, 1922.

ACCORDING to the authors' views all annular lung shadows should be considered cavities until study by every possible means justifies some other interpretation.

They disagree with Sampson, Herse and Brown, and also with Amberson, all of whom consider these annular shadows to be indicative of pleural disease. Drs. Burnham and Brown say: "We believe that the theories advanced by these authors are interesting, but wholly unconvincing and unsupported by proof of any kind, and particularly not by autopsy."

By means of a device which makes films of the lung routinely in one-fortieth of a second, thus cutting to a minimum transmitted motion from the heart and aorta, they have secured greatly increased detail in films. A perfectly definite opening of a bronchus into a cavity, at or near its lowest point, has been observed in three cases of annular lesions of unusual type. The authors find that in certain cases cavities may form rapidly and disappear the same way.

The effects produced by artificial pneumothorax in unilateral cases, the authors believe, offers additional proof that they are right in their conclusions. "This is especially applicable to the ring shadows in the upper third of the lung, where the shoulder joint and spine prevent the taking of lateral views. If these shadows be pneumothoraces bound by adhesions, it will be made plain when the adjacent lung is collapsed." If adhesions hold the entire apex in place the outline of shadow or cavity is frequently altered. Even the successful but incomplete compression of the lung may not collapse an unquestioned cavity on account of the rigidity of the cavity walls. Serial plates after the addition of more and more air show two things that are significant, namely, a lessening of the size of the cavity or alteration of its shape, and a change in location, neither of which would take place if the outline in question were due to adhesions between lung and wall.

X-rays in the Diagnosis of Gastro-Intestinal Diseases in Childhood. H. Martin Berry, M. D., Practitioner, 119:99, July, 1922.

IN CHILDREN the limits of normal variation of shape, size, position and function of the stomach are much wider than in the adult. The normal adult shape is not even approximated until after the second year of life, usually much later, and the stomach lies higher and more transversely in the abdomen

with the pyloric opening directed farther backward.

It is not generally recognized that a bismuth meal examination is valuable for any but the adult patient. This is to be regretted for the examination of the child by this means yields at times very valuable information.

The emptying time cannot be gauged as in adult stomachs; in a normal child food will be seen in the duodenum in a few minutes and usually the greater part will be expelled in from one and one-half to two and one-half hours, though the remainder may linger a long time.

Also, in the child, the mechanism of empting differs—there are no definite waves of peristalsis as in the adult stomach and the food seems to be expelled by contraction of the stomach as a whole. Decided peristaltic waves in the infant stomach indicate obstruction, just as in adults. Functional ability of the pylorus can be observed and this is of value sometimes in indicating the need of Rammstedt's operation, which has been successfully borne by infants.

Carcinoma of the gastro-intestinal tract in children is very rare, though it has been found. Gastric ulcer is more likely to be found. The author has twice encountered diaphragmatic herria of the stomach in children.

Many problems of infant feeding may be solved by the sophisticated use of the x-rays. The effect of change of diet on gastric motility may be studied by the addition of a small quantity of bismuth to the food, and the suitability of prescribed diet thus quickly determined. The presence and amount of gas in the digestive system can also be studied by the x-ray.

Diminished nutrition is often due to the distension of the stomach by gas which may have been swallowed (air) or produced by fermentation or by regurgitation. Of course, some gas is normally present. Interesting facts regarding posture in feeding have been brought to light by x-ray study. The erect position is the best for feeding because less air is then introduced into the stomach.

Malposition and adhesions may be distinguished. Enlarged mesenteric glands may simulate gastro-intestinal pathology and can be detected by the x-ray. It is also useful in detecting vesical and renal calculi which may occur in early life.

The four abstracts following are from a symposium delivered at the first Bilingual Congress of Radiology and Physiotherapy, held in London this past spring and proposed to be held annually in France, Belgium or England.

Discussion of the Normal Stomach. Drs. Lebon and Colombier, Paris. Arch. Radiol. & Electroth., 27:34, July, 1922.

THIS DISCUSSION is treated under the headings: The Stomach as Described by the Anatomists; The Radiological Examination; Infant and Adult Stomachs as Revealed by the X-ray.

The author's conclusions are here quoted (translated): The infant stomach with its oblique axis from top to bottom and from left to right resembles the form of a horn which the older anatomists used to state was the form of the adult stomach.'

The adult stomach, on the contrary, lies vertically in the abdominal cavity to the left of the median line, and in the majority of cases it has the form of the capital letter J.

The pylorus is situated on the horizontal line passing through the middle disk at the third or fourth lumbar vertebra, and is located, according to the type of normal stomach in which it appears, either to the median line or to one of the two parasternal lines.

The lowest line of a normal stomach does not descend below the line that joins the tips of the two iliac crests, however full the stomach may be. Normal contractions are sluggish in movement, about three per minute, and they begin with the arrival of the food at the lower level of the stomach. A normal stomach does not reveal the presence of food by any sign of pain whatever.

The normal stomach depicted by the x-ray will lie in a plane bounded by the following lines: Above, the diaphragm; below, the ilium; at the left a line passing through the mammary gland; at the right the median line or one of the two parasternals.

The same type of meal should be employed routinely. If the French preparation- of "gelobarine" is employed the normal stomach should empty itself in at least two hours and a half.

The Normal X-ray Stomach. M. Peremans, M. D., Antwerp. Arch. Radiol. & Electroth., 27:46, July, 1922.

THE BARIUM filled stomach revealed by screen or plates is in many respects different from the anatomical descriptions found in the texts. However, whether the x-ray stomach is an absolute standard or not is not so important to the radiologist.

Instead of a barium meal the author uses barium milk, which is a French preparation. It is an emulsion of 100 grams of barium sulphate and 100 grams of water with enough paraffin and agar to give a standing solution; to this 200 grams of water are added before using.

The examination of the patient starts at 9 a. m., and a second examination is made at 1 p. m. Later in the afternoon the examinations are repeated. No food or drink is allowed between the first and the second examinations. Screen examinations are made in the upright position and plates are made thus also. A few hours retention is considered abnormal.

Because of economic reasons the serial plate method is little used. An effort is always made to have the referring physician present at the x-ray examination, but if this is impossible all the clinical and laboratory records are obtained before the x-ray examination is made.

The Abnormal Stomach. Sir A. Reid, K. B. E., C. M. G., Arch. Radiol. & Electroth., 27:52, July, 1922.

ALTHOUGH the ideal examination consists of exhaustive screen examinations supplemented by plates, the author urges that because of the dangers to the roentgenologist, attendant upon frequent screening of patients, the plate examination should be used as much as is consistent with reliable diagnosis. He believes that the serial plate method will in most cases yield all necessary information, but when the screen must be resorted to that the utmost possible protective measures should be employed.

He also believes that it is quite possible to invent an automatic device by which palpation can be accomplished without keeping the hand in the path of the rays. In his own laboratory he is working out a method in which serial examinations are made at intervals of two seconds, making six 4 by 5 inch exposures on a 12 by 10 inch plate. He hopes by improving this method to obtain increased accuracy of detail in the pictures.

Present Day Value of the Opaque Meal Examination in Gastric Lesions. S. Gilbert Scott, M. R. C. S., L. C. R. P., London. Arch. Radiol. & Electroth. 27:58, July, 1922.

THIS WRITER uses a card index for every case. Each item noted upon examination of the patient is entered as is also the ultimate diagnosis, and later checked with the operative findings. He finds this detailed method often leads to improved methods of technique and has a distinct reaction upon progress in his laboratory.

When the x-ray diagnoses are found to be greatly at variance with the operative findings the cause is usually found

to be the impaired vitality of the roentgenologist. A great deal of stress is laid upon the fact that every x-ray laboratory worker should have at least two hours daily in the open air and that one day in the week he should not enter the x-ray laboratory at all. Unless these precautions are heeded in the writer's laboratory the result is decreased accuracy in diagnoses.

The emptying time of the stomach has such wide variations, due to so many causes (as much as four hours difference in the emptying time of the normal stomach can be induced by diet alone) that as a diagnostic sign it has a quite unreliable value.

Screening alone or the serial plate method alone is not a wise procedure in the main. This author believes that it is almost necessary to use both as a routine.

He believes that the time is coming when all gastric lesions may be detected radiologically, that is, their presence will be revealed though the exact diagnosis may not be arrived at for every lesion.

Gastro-Intestinal Roentgenography. Editorial, Am. J. Surg. 36:232, September, 1922.

APROPOS of the incompetent roentgenologists who bring discredit upon the profession, this editorial says: "The patient usually regards the x-ray pictures as photographs of his intestinal tract and is accordingly prepared to accept the report as a finality. So, often, does the physician, especially if it coincides with his own loose diagnosis of "chronic appendix," if he is without experience in roentgen diagnosis and is unable to interpret the films, if, indeed, he even sees them. * * * Every surgeon of experience must be convinced that the percentage of cases in which chronic appendicitis can be demonstrated roentgenographically must be small; yet how often the diagnosis is made by some who set themselves up to be roentgenologists. * * * Variations in the shadowed outlines of the esophagus, stomach and intestines demand experience in interpretation. Not all of those who conduct x-ray laboratories are competent to make those interpretations."

The Writing of Medical Papers. Editorial, Am. J. Surg. 36:233, September, 1922.

THE WRITER of this editorial says: "Some of us, of course, are quite unable to write well—either because of careless habits of thought and expression or because of lack of training in composition. They may be forgiven and deserve editorial indulgence; many a brilliant university graduate is a 'poor speller.' Some, however—and they do not deserve forgiveness—do not take the trouble which they should, to revise their articles again and again, until they have eliminated all that is unnecessary and repetitious, and have expressed the remainder in clear, grammatical and well punctuated sentences. Some, indeed, do not go over the final sheets to correct their typewriter's errors. * * * The American Medical Association publishes a pamphlet on Bibliographic Style and Suggestions to Medical Authors (25 cents) that ought to be more generally studied. * * * In a rather long editorial on 'How to Write a Medical Article' (Am. J. Surg., March, 1921) we, too, pointed out in a spirit of goodnatured satire the common faults in medical composition and the preparation of medical papers." (Note: Reprints of this article are available. It contains vital editorial truths dressed in a form to rival "Life" and "Punch.")

Besides the pamphlets published by the A. M. A., the writer praises very highly a book just out, "The Writing of Medical Papers," a review of which appears in the Journal this month.

Carcinoma of the Esophagus with Perforation of the Aorta: Observations on Radium Therapy. James G. Carr, M. D., *and* C. W. Hanford, M. D., Am. J. Med. Sci., 164:340, September, 1922.

"SINCE the publication of Knaut, in 1896, 21 cases of esophageal carcinoma with perforation of the aorta or other large vessels have been reported. Another case is added here.

"Autopsy findings in the case here reported disclosed certain deficiencies in the application of radium therapy. Suggestions are made for more effective technique.

"Radium therapy of esophageal malignancies has to contend with certain problems as yet unsolved. The disease * * * has often invaded neighboring organs before the symptoms have become sufficiently disturbing to send the patient to a physician. Carcinoma of the esophagus spreads by continuity of tissue; far less often do metastases occur. In the patient apparently improving, with less obstruction, greater ease of swallowing, some gain in weight and strength, symptoms of pulmonary involvement often supervene * * * due to the presence of a secondary mediastinal tumor. To these causes of failure must be added the technical difficulties of the introduction and location of the radium; the diseased area must be sufficiently dilated to admit the capsule containing radium; emplacement must be controlled by fluoroscopy. It appears from the autopsy * * * that one portion of an esophageal carcinoma may be treated successfully while another portion is missed altogether. * * * Until the tumor, for its entire length, is permeable to a sufficient degree to admit the capsule, so that the capsule may be passed the entire length and redrawn into the area, to be located at different levels, we cannot feel that our technique is directed to the treatment of the accessible growth in its entirety."

Treatment of Diphtheria Carriers with the Roentgen Ray. Dalton Kahn, M. D., Am. J. Electroth., 90:287, September, 1922.

DIPHTHERIA carriers ranging in age from seven weeks to 59 years were treated by the roentgen rays with very gratifying results in this preliminary study of 185 cases.

It is not claimed that the action of the rays is bactericidal, but that the shrinkage of tonsils and of lymph tissue establishes drainage which eliminates the infection.

The average time from treatment to release was eight days. Eighteen cases had negative cultures upon the day of admittance, which eliminated them from the study. Thirty-four of the others were released upon negative virulence tests. One hundred and twenty-nine were released upon two or more negative cultures following treatment. A few cases required from three to four treatments; about fifty required two treatments and more than one hundred required only one treatment.

Further Attempts at the Experimental Production of Carcinoma by Means of Radium. W. S. Lazarus-Barlow, M. D., F. R. C. P., Proc. Roy. Med., 15:7 (Sect. Path.) April, 1922.

THE EXPERIMENTS here described are a continuation of those reported in 1918 in the same journal (11:1, Sect. Path.)

In the experiments reported in April, 1922, radium bromide was introduced intraperitoneally into 48 rats. The amounts varied from 0.011 mg. to 0.15 mg. and were inclosed in minute sealed glass tubes. Exposure extended up to 270 days. Ancillary treatment in the form of feeding potassium metasphosphite or exposing to a "suitable dose" of x-rays was carried out before and after introduction of the radium tubes.

Careful postmortem and microscopical examination revealed conditions which could be regarded as possible

criteria of neoplastic growth, but the extent of the change was difficult of interpretation because it was limited—the main mass showed itself either completely degenerated or frankly inflammatory under microscopic examination.

It was concluded from this study, however, that rats are remarkably resistant to induced carcinoma. No criterion was found in 9 animals, one criterion was found in 19, two criteria were found in 17, and three criteria were found in 3.

Malignant Glands and Their Proper Treatment with Radium. C. W. Hanford, M. D., Illinois M. J., 42:214, September, 1922.

MALIGNANCY at the side of the tongue usually metastasizes first to the submaxillary on the same side, then to the sublingual or one of the cervical glands. If the primary lesion of the tongue is at the side, but more toward the back, the lymph glands at the base of the tongue and those near the larynx will be involved early, but in such cases the prognosis is very unfavorable. If the primary growth is at the base of the tongue then the tonsil of that side is usually the first to be involved and next the cervical gland just under the ear.

In epithelium of the lower lip the submaxillary and sublingual glands are first involved and metastasis may extend to the bronchial lymph glands—perhaps even farther.

If the primary growth is in the buccal cavity the submaxillary gland is usually the first to be involved, though the parotid may be invaded at the same time. Metastasis spreads to the cervical chain as far as the supraclavicular region and has been known to reach the mediastinum. Pain in these cases is not very noticeable "until the gland just back of the mastoid attachment of the sterno-clido-mastoid becomes invaded. Then the patient complains of pain in the ear and occipital region."

In cancer of the tonsil the cervical glands are early invaded. Primary cancer of the tongue and buccal cavity may heal while metastases still continue.

In the majority of cases in general, metastasis is on the side of the initial lesion, but this is not always so.

Clinical evidence from the author's own practice leads him to believe that the administration of thyroid extract has considerable effect in strengthening the patient's resistance.

Pre-operative radium treatment is strongly recommended for these lesions.

The Secondary Manifestations of Malignant Disease. Alexander Primrose, C. B., M. B., C. M., Ann. Surg., 76:312, September, 1922.

PALPABLE glands in the axilla in cases of breast tumor are suggestive of but not pathognomic of malignancy. In contrast to this the local lymph glands in carcinoma of the breast may escape infection but distant metastases be present, due to the primary breast lesion. Entire absence of metastatic growth in a case supposedly malignant should arouse suspicion that a wrong diagnosis has been made. This is especially noted with regard to so-called primary carcinoma of the appendix.

"An abscess developing in connection with glandular metastases in cancer may be the first clinical evidence of the disease and the serious nature of the case may be completely masked by it."

In cancer of the rectum the frequent metastases to the lymph glands and to the liver makes an exploratory operation a wise procedure previous to a radical operation or a colostomy.

Implantation of carcinoma upon serous surfaces, especially in the peritoneum, the author regards as a very serious danger—an argument against the two stage operation and for the most careful technique in operation.

Malignancies, especially the sarcomas, are disseminated by the blood stream as well as in other ways.

Bone metastases of cancer is more frequent than used to be believed and the x-ray has proved of very great value in its diagnosis. Since these lesions may be entirely unsuspected by both patient and physician, an x-ray examination should always be made upon complaint of pain in any bony part, especially the spine. "Treatment of these cases by the radiologist may possibly be of some service. It is impossible to make any definite statement in this regard, but certain cases would appear to be relieved of pain and to improve in general health under this treatment."

Recurrence Versus Metastasis in Carcinoma. Ellsworth Eliot, Jr., M. D., Ann. Surg. 76:324, September, 1922.

THE WRITER believes that "the independent development of a second carcinoma without any etiological relation whatever to the original growth which, presumably, was completely and successfully removed" may and does occur, though this cannot be actually proved. Six cases are cited which seem to uphold his opinion upon this subject.

End-Results in Cancer as Influenced by Type, Reaction, Location and Age. Charles H. Mayo, M. D., Ann. Surg. 76:308, September, 1922.

DR. MAYO read this paper before the American Surgical Association, May, 1922. He briefly reviews the subjects of cancer statistics, the hypotheses of its etiology, and the progress made in its pathological study and treatment during the later years.

Dr. Mayo makes the vivid statement that more citizens perish of cancer during one year than our country lost altogether during the great war.

Of roentgen rays and radium he says: "Roentgen ray and radium in the treatment of cancer have made marked progress in a very serious group of cases. When this form of treatment was first undertaken only those whose condition was too far advanced for surgery were considered suitable subjects. * * * Many early and some late cases, according to the location and type, have apparently been cured by such treatment. When vascularity is one of the features of the condition radium is most excellent. The end-result of both roentgen and radium therapy is the development of fibrosis, which often changes the type of malignancy."

Roentgenotherapy of Malignant Neoplasms, Especially Carcinoma. C. Steinthal, M. D., Stuttgart. Muenchen. med. Wchnschr. 69:3, July 28, 1922.

A CONSERVATIVE view of the subject of roentgenotherapy of carcinoma is taken. Roentgen treatment of sarcoma, especially the lymphosarcomas, yields better results, although the author states that he does not share the enthusiasm of the Frankfurt Clinic upon this subject. However, present results, disappointing as they are, do hold some promise for the future. In the author's clinic better results have been secured in the treatment of tuberculous glandular lesions than in treating carcinoma or sarcoma.

A British Medical Association Lecture on the Problem of the Radium Therapy of Cancer. Arthur Burrows, M. D., B. M. J., 2:33, July 8, 1922.

THE TECHNICAL difficulties encountered in deep therapy are presented in this paper.

The three conditions upon which destruction of a cancer cell depends "are variable and are made up of variables." These conditions are: A known quantity of rays, the lethal dose of the cells of a certain cancer, and the size and situation of the tumor. Its size, density and depth affect the quantity and quality of the rays penetrating the whole growth. The former difficulty is easily overcome, the latter one only by imbedding radium tubes,

or by varying the distance of the applied radium from the skin, and all tumors are not suitable for this treatment.

The lethal dose for a certain tumor must be established for a definite type of ray and this may have to be changed for a change in position of the growth so slight as only one centimeter in distance.

Rodent ulcer of the skin is easily cured by radium, but rodent ulcer invading bone is a different problem and is rarely cured. Round cell sarcoma, though usually cited as a lesion responding well to radium, does not give as good an end-result as spindle cell sarcoma, although the latter lesion is more difficult to treat.

Large tumors, aside from the difficulty of even radiation, commonly have a poor blood supply at the center and this is an important factor to be taken into consideration in treating these tumors.

When a tumor is of an irregular outline or has varying densities the problem of dosage becomes very complicated.

Not only is the nature of the tumor an important factor in ray treatment, but so also is the nature of the tissue and organs which it invades.

"What is needed is a large number of physical measurements of the different parts of the human body, and of pathological growths, and a full and complete investigation of the nature of the lethal dose for cancer cells; * * * even then it seems that a number of unponderable biological problems such as the resistance of tissues locally to cancer growths remain to be solved * * *

"Seven and one-half per cent of all the cancer cases (mostly inoperable) which came to Manchester for radium treatment are alive and well today after periods varying from two to seven years, and many cases of carcinoma of the uterus, breast, skin, lip, and other regions are in perfect health, which would but for radium be dead; while endotheliomata of the parotid gland and spindle-cell sarcomata show still more gratifying results * * * much valuable palliation work is done, while in * * * exophthalmic goiter, Hodgkin's disease (when young), keloid, cavernous and capillary naevi, the percentage of cures is high; finally radium is specific for excessive uterine hemorrhage and spring catarrh."

The End-Results of Operations for Cancer of the Bladder. William E. Lower, M. D., Ann. Surg. 76:352, September, 1922.

THIS STUDY of end-results is confined to those from surgical treatment. "The results of recent methods of treatments by some form of radiation—radium or the x-ray—cannot properly be included at this time, not because we believe this may not be the method of choice in the future, but because sufficient time has not elapsed for the end results to be established."

Simplifying the Diagnosis of Some Kidney and Bladder Diseases by Use of the Cytoscope and X-ray. O. J. Sloan, M. D., Illinois M. J., 42:184, September, 1922.

SOME urological pathology gives no evidence on the x-ray plate. Those which commonly give positive evidence are urinary calculi, deposits of mineral salts in various parts of the urinary tract, and inflammatory calcifications. "Some roentgenologists claim that 15 per cent of calculi in the kidney, 35 per cent in the ureters, and 60 per cent in the gall-bladder cannot be shown by x-ray."

Positive diagnosis of any particular type of pathology from the shadows of a supposedly enlarged kidney must be cautiously rendered for msitakes are easily made here.

The author's conclusions are: "(1) In all cases where symptoms are referable to the urinary tract the combined method of examination with the cytoscope and x-ray is indicated. (2) Urological lesions are frequently diagnosed by the aid of the x-ray when diagnosis is doubtful otherwise. (3) In 50 per cent of urological cases the x-ray shows negative pathological conditions, but with the combined method the diagnosis can usually be made. (4) X-ray findings should in all cases be verified by the urologist before a conclusive diagnosis is given. (5) The combined method is the ideal procedure in the diagnosis of most urological conditions."

The Clinical and Radiographic Dental Aspects of Focal Infection. Clarence J. Grieves, D. D. S., Dental Cosmos, 64:29, September, 1922.

RACHITIC, syphilitic and tuberculous bone lesions are recognized by characteristic changes in the hard tissues, but full knowledge of the systemic and local disease, as well as the x-ray picture is necessary for a proper diagnosis. To illustrate, no authority upon the subject would announce that rarefaction, appearing in the bone, is an infected focus because the trabeculae are missing. The radiogram may be taken as significant evidence only if it is confirmed by the pathological and clinical history.

"In the study of oral films, the dependable osseus landmarks which indicate disease are the density and regularity of the lamina dura and the orderly patterns of associated trabeculae. The generally clear outline of root surfaces, defining periodontal width, as seen in accurate radiograms of normal alveoli, is most important The condition of all visible parts of the lamina dura must be carefully noted, for it records the amount of bite stress or disease involving the attaching tissues.

"In gingival disease the loss of septal alveolar crests is indicated by the disappearance of the lamina at the gingival borders; if these areas are rarefied with vague trabecular outlines the invasion is deep and the outcome of treatment doubtful; if the rarefied areas are sharp and surrounded by the condensing type of ostitis, and the trabeculae sclerosed, the prognosis is more favorable.

"Pyorrhetic invasion of the molars and bicuspids which approach the antral floor must be explored, for it may produce an obscure antritis. Occasionally deep pockets are hidden by roots superimposed on the film, but generally a close study of all lines in view, representing cemental surfaces, periodontal and laminar regularity, and the character of the trabeculae, will detect the lesion.

"Periapical abscess and proliferating periodontitis, extending all around the apex are always visible in several films from different angles. These must and can be sharply differentiated from regular bone absorption due to traumatizing occlusion, as under bridge abutments.

"In the early stages of acute alveolar abscess, as in other acute bone lesions, the radiogram indicates little; this is also true of freely draining alveolar fistulae. In the subacute and chronic stages, as the granulomatous and cystic types, the radiogram can be more accurately interpreted.

"In diffuse granulating phases of apical disease, the areas are large and the spongiosal patterns blurred, with little definition; in granulomata and cysts complete rarefaction occurs, surrounded by a line of condensing ostitis. * * *

"The radiograph will not show granulating apical disease on deciduous disease except during the short period when their apices are complete. Before the eruption of the permanent teeth, the whole anterior maxillary region is occupied by the tooth crypts of the permanent crowns and is normally rarefied. A radiographic diagnosis of deciduous apices is thus obviously impossible. Purulent abscesses involve deciduous teeth and may be foci, but it is questionable if the granulating stages, which are said to so actively focal in adults, exist at all in children.

"In the location and removal of impacted teeth the radiograph plays a most important part. * * * Where impaction is associated with gingival disease, invasion of deep third molar crypts by way of the second molar attachments frequently results. These areas must be carefully explored and radiographed, for they may escape observation and cause serious systemic disease."

The Therapy of X-rays in Dentistry. Erich Knoche, Munich, Dental Cosmos, 64:960, September, 1922.

MORE than 70 cases of chronic periodontitis have been treated by this author during the last three years, with very encouraging results.

Surgical methods give satisfaction, but sometimes are contra-indicated. The author believes that x-ray therapy combines all the advantages of medicinal and surgical methods of treatment and that it has not any of their disadvantages. X-ray therapy for inflammation of the gingival margin and pyorrhea alveolaris is useless as these symptoms disappear as soon as their cause is resolved.

"Through the influence of the radiation a new formation of bone begins at the margin of the seat of the disease, which, according to the extent of the absorption, is filled in a few months with new bone. The progress of the new formation is easily determined by the roentgenogram.

"Fistulas disappear in about a fortnight, clinically, and subjective symptoms disappear in about three weeks. It is better to radiate the alveolar process directly to avoid epilation or pigmentation of the skin.

"Damages from the x-rays, which could not be repaired, have never been seen and ought not to be feared when the proper technique is carried out. Children, however, have been excluded from the treatment, as the youthful epidermis is very sensitive to x-rays."

None but an x-ray specialist should administer the rays for this treatment.

A Laboratory and Clinical Study of the Bactericidal Action of Solutions of Radium Emanation. John Albert Marshall, D. D. S., Ph. D., California State J. Med., 20:8, January, 1922.

DENTAL apical abscesses treated with a radio-active solution form the basis of this report. The experimental work was done by the author to ascertain the therapeutic value of radium emanation used as bactericidal agent in chronic dental apical abscesses.

The work of Lequeux and Chrome, and that of Iridell and Minett is cited regarding the bactericidal action of radium upon streptococci.

The method used by the author was to crush a capillary tube of radium emanation in a sterilized mortar, previously covering the emanation with Ringer's solution. This radio-active solution was then immediately conveyed to the root canals of the tooth by means of J. and J. sterilized cotton points, which were sealed in the canals for from one to four days. They were then removed, the pulp canals tested for sterility, and filled.

Observations of nearly a year's clinical cases of chronic dental apical abscesses have shown that these lesions yield readily to this treatment with no untoward events to date. There was succeeding soreness and pain in only one case.

Further laboratory data are being sought before final conclusions are drawn from these studies.

Note on the X-ray Diagnosis of Rickets. Hans Wimberger, M. D., Lancet, 203:11, July 1, 1922.

"DIAGNOSIS of rickets by x-ray is based principally upon careful observation of quantitative alterations in calcium content of the bones. This demands frequent photography and must reach a high standard of technique. Changes in the form of the bones are a second diagnostic point when the disease is well established."

The primary calcification zone first loses its homogenity and appears wider and less well defined. The sharp end-margin of the metaphysis is lost as calcium content is reduced and a fine fringe shows. The terminal part of the bone decalcifies more rapidly at the center than at the periphery, and it will show a coarsened structure due to a replacement of calcified tarbeculae by osteoid tissue, perhaps even to a degree that prevents distinction of bone from soft tissues.

Beginning of healing is easily recognized by the appearance of a "new primary calcification zone between the epiphysis and the abnormal (radiographically invisible) tissue found in the metaphysis during the rachitis period."

For about two years after rickets of even a moderate degree the difference in structure between the healed metaphysis and the portion of the diaphysis formed before the onset of the disease will be quite apparent.

"The earliest symptoms appear in the most rapidly growing metaphyses, which also suffer most damage when the disease is prolonged." Examples cited are the sternal ends of the ribs, distal ends of femur, proximal ends of the humerus, tibia and fibula. The ribs are not suitable for diagnostic plates.

X-ray photographs are the most accurate means of ascertaining measurement of bone growth. The most rapid growth of normal bones is in the spring and early summer and the slowest is from December until March. In rickets retardation of growth appears earlier than in normal infants and often a long period of absolute cessation of growth precedes the disease.

The Etiology of Rickets in Infants. Drs. Chick, Hume, Mackay, Smith and Wimberger, Lancet, 203:7, July 1, 1922.

INVESTIGATIONS carried out during the last eighteen months at Vienna show that rickets can be cured by cod-liver oil or by exposure to sunlight or to the rays from a mercury vapor quartz lamp. The lamp used was the Hanau pattern and treatment was given three to four times weekly beginning with five minutes exposure at a distance of 80 to 100 cm., the time being gradually increased to thirty minutes and the distance to 60 cm. Full dosage was attained in two to four weeks, according to the age and condition of the patient. Results were radiographically indistinguishable from those secured with cod-liver oil, and healing was apparent in from two to four weeks after a total exposure of two to five hours. Results were the same whether one limb, one side, or the whole body was rayed.

It was found that rickets developed during the winter and spring (under excellent hygienic conditions) in infants receiving a diet of sugar sweetened fresh milk. All milk was from stall-fed cows. In children receiving a diet containing cod-liver oil, more milk and less carbohydrates, rickets did not occur. During the summer months rickets did not develop at all upon either diet.

The first six months of infancy is a period of special susceptibility to the onset of rickets and the disease may develop in an infant whose general condition is good, also improvement and healing may occur independently of improvement in the general condition.

The Thymic Shadow in Infants. I Edward Liss, M. D., Am. Jour. Dis. Child., 24:192, September, 1922.

AN X-RAY examination of 119 new-born infants was made in this study, the plates being made within forty-eight hours after birth. It was planned to make another examination ten days later and monthly after that for two years, but it was not possible to follow up the entire 119. However, a sufficient number were so followed up to make the report worth while.

Forty-two per cent of the children examined within forty-eight hours after birth showed thymic shadows measuring more than three centimeters transversely which in this writer's opinion is a pathological sign.

The conclusions drawn are: "(1) Thymic shadows can easily be determined in the new-born and in infancy. (2) Transversely enlarged shadows are present in a strikingly high percentage of the new-born. (3) This shadow may be present without symptoms or physical stigmata. (4) There is a definite tendency toward a spontaneous retrogression of this shadow during the first year, but some glands persist beyond this period. (5) There is a type of thymic shadow cast by a pedicle-shaped organ, the mass of which lies on the heart, from which it cannot be differentiated. (6) In the later months of infancy the presence of large parabrancheal glands and prominent blood vessels presents some difficulty in differential diagnosis, but differentiation is possible."

A Case of Hodgkin's Disease Treated with Roentgen Rays for Six Years. Kenneth R. McAlpin, M. D., *and* William C. Von Glahn, M. D., Arch. Int. Med. 30:287, September, 1922.

THE PATIENT was a woman 20 years of age. Her chief complaint on admittance to the clinic was pain in the abdomen and a general weakness. There was a burning pain in the left side, radiating to the back. Twenty days after admission a hard, irregular, freely movable mass was felt in the lower right quadrant. The x-ray examination of the abdomen was negative for glands.

An exploratory operation revealed numerous enlarged glands in the mesentery of the hollow viscera, some of these measured five centimeters in diameter, all were yellowish and of a cheesy consistency. The pathologist's report was Hodgkin's disease.

Roentgen ray therapy was begun about three months after the above operation, the second treatment followed a month later. The patient felt better and roentgen ray treatments were given every two weeks for more than three months, when the patient was again admitted to the hospital.

The disease was slowly progressive. There were periods when she was very ill, which were followed by periods of improvement, but the acute stages became longer in their duration and improvement after each one correspondingly less marked. Her temperature was of a recurrent type and her blood pressure was very low from the time of admittance.

"Our patient was treated 95 times with roentgen rays * * * apparently the glands decreased in size, especially the cervical nodes. * * * The number of areas were changed from time to time, but were always so arranged that all the contents of the thorax and abdominal cavity were exposed to the rays. * * * It is safe to say that the roentgenotherapy slowed the process, but in no sense cured the condition."

Roentgen ray and blood transfusions (nine in all) were the only therapeutic measures used, with the exception of sedatives. Radiation was discontinued six months before death because of general weakness and the low blood cell count.

Death was due to a perforation of the intestine. During life the spleen had been thought to be considerably enlarged, but at necropsy it was found only slightly so. The unusual pathological findings were extensive involvement of the peritoneum and abdominal viscera, a tendency to regional invasiveness, atypical giant cells and a scarcity of eosinophiles.

Clinical Types of Goiter and Their Management. Charles A. Elliott, M. D., Med. Clin. N. A., 5:1623, May, 1922.

THIS AUTHOR says: "We have not observed the definite and lasting results which would stamp these agents as all sufficient in the treatment of hyperthyroidism," but it is stated that perhaps these agents have not been perfectly applied.

"In general it must be admitted that radium and x-ray may be sufficient in any given case and that they are useful in reducing hyperthyroidism preliminary to operative interference." In selected cases of toxic goiter radium or x-rays may be indicated and in exophthalmic goiter they may be advisable preliminary to a subtotal thyroidectomy.

The Treatment of Cancer of the Jaws. Albert J. Ochsner, M. D., Ann. Surg. 76:328, September, 1922.

DR. OCHSNER since 1901 has operated 126 cases of malignant tumors of the jaw. The last 26 of these have been added during the past four years and the first 100 were reported upon four years ago.

The tumors in these cases have been removed by the cautery and this operation has been followed by intensive x-ray treatments. Besides these operable cases, many inoperable ones have been given palliative x-ray treatment.

"So much progress has been made in the use of x-ray and radium that in the next few years there may develop marked changes in the treatment of these cases. * * * Our observation has convinced us that early and very extensive operation with the cautery, followed by carefully planned after-treatment with x-rays or radium, is quite worth while in these cases and that occasionally even advanced cases will be permanently cured by this method."

Endothelioma of the Dura. Charles Louis Mix, M. D., Med. Clin. N. A., 5:1673, May, 1922.

THIS is an account of a case of Pott's puffy tumor. Frequent forenoon headaches and occasional "stopping up" of the head were at first the only symptoms. The roentgenologist's report was negative, and this, plus symptoms, led to a diagnosis of sinus infection. However, treatment gave no relief and the patient came under the writer's observation September 21, 1921. The roentgen findings were again pronounced negative, but the physical findings revealed a slight puffiness of the scalp in the left occipital region. This was accompanied by a higher degree of temperature than was the surrounding area.

Upon operation the scalp was found somewhat edematous in this area and the bone area directly beneath was found diseased. Trephining revealed diseased bone clear through to the underlying dura, which was firmly adherent to the brain tissue. Dura, arachno-pia and cortex were grown together in an indistinguishable mass. This mass was cut away. Strands of endotheliomatous cells extended down along the blood vessels as far as the section of brain removed.

The wound healed slowly. A resultant hemonymous hemianopia is attributed to the operation having involved the higher visual cortex. This suggests "that the exterior occipital cortex is as much a center of ultimate sight as the cuneus on the mesial aspect of the occipital lobe." Occasional slight headaches still appear.

Postoperative x-ray treatments are regarded as very important in this case and intensive treatments were given monthly until January and since that time have been given at intervals of two months.

Re-examination of the roentgen plates taken before operation showed that the x-ray had revealed the area of diseased bone, as a slight disturbance, but the attention of the roentgenologist had been centered on the supposed sinus infection and the shadow had passed unnoticed.

The End-Results of Treatment in Certain Forms of Malignancy of the Neck. Martin B. Tinker, M. D., Ann. Surg. 76:335, September, 1922.

THE DATA for this study were collected from 38 surgeons.

The author classifies malignancies of the neck into three groups, which, with the treatment recommended, are as follows: (1) Operation contra-indicated in metastases to the neck from tonsillar or pharyngeal growths or those of unknown origin. Radium or x-ray should be used for the tonsillar and phryngeal malignancies. (2) Operation offers a reasonable chance of recovery in early cases of malignancy of the thyroid, malignancy originating in bronchial cleft remnants, carotid gland tumors and those of the parotid, also in early cases of Hodgkin's disease. (3) Operation offers little hope in advanced cases of Hodgkin's disease, advanced thyroid malignancy and advanced branchial cleft carcinoma. Radium or roentgen rays with or without surgery is advised for these cases. Palliation is assured and occasionally there follows an apparent permanent cure.

A Case of Pneumothorax Following Breathing Exercises. James Crockett, M. D., Lancet, 203:330, August, 1922.

THE PATIENT in this case, an active and athletic young man, upon going through his daily breathing exercises one morning felt a sharp pain in his chest and became breathless. This passed, however, and after breakfast he took a forty-five mile run on his motorcycle, but became very ill upon reaching his destination.

An x-ray picture revealed the lung completely compressed against the mediastinum with a band of adhesions stretching from the lower mediastinum to the axillary area. The adhesions would seem to indicate that at some remote time there was present an active tuberculous lesion of the lung, although no history of such a lesion could be elicited.

The patient's temperature has been normal from the first, but his pulse rate was ninety. The pulse rate has become normal and the lung is slowly expanding at the present time.

Grundriss der gesamten Roentgendiagnostik innerer Krankheiten fuer Aerzte und Studierende. By Fritz Munk, Lecturer in the University of Berlin. 292 pages; 193 illustrations. Second edition, 1922. Published by George Thieme.

IN THIS comparatively small book the author has carried out the purpose, avowed in his preface, of presenting some of the essential facts of roentgenologic diagnosis for the benefit of students and physicians who do not intend to practice roentgenology as a specialty.

There are chapters on technique, on the examination of the heart, lungs, stomach and abdominal organs, urinary apparatus and bones. Except for references to Cannon and Skinner only German references are mentioned in the bibliography. The illustrations are small and not conspicuous for their excellence. Chapters on the heart and lungs are of about equal length, and take up almost half the book.

To roentgenologists the book is bound to be disappointing, but the author expressly disclaims any intention of writing for their instruction. To clinicians it cannot fail to be of some value, for it sets forth more than most of them know concerning roentgenology.

And this brings up the perennial question of how to obtain maximum service from the x-ray. The work of a well trained roentgenologist is undoubtedly superior, but he is not always available. Thus, the essence of the question is whether the clinician employing the x-ray himself adds to his correct diagnoses or increases his mistakes. At all events, if he is obliged to use the roentgen ray he should acquaint himself not only with the striking phenomena, which are easily recognized, but also with the numerous diagnostic pitfalls which are far less easily learned.

There is no royal road to roentgenology.

R. D. C.

The Writing of Medical Papers. By Maud H. Mellish, Editor of the Mayo Clinic Publications. 16 mo. 146 pp. and index. Philadelphia and London, W. B. Saunders Co., 1922. Cloth, $1.50 net.

THIS AUTHOR has written a little book which will prove a useful servant to nearly every medical writer who may chance to employ it.

There are multitudinous technical points necessary to proper literary form, which, although taught in both high school and college, have never been learned by the average graduate of an American college or university. The first 65 pages of this book deal with just these technicalities which often perplex writers, and, if not observed, at times confound their readers.

It may be too much to expect that every medical writer will set himself to the task of acquiring a better knowledge of these points, much as his literary style would profit thereby; some men are too busy, some are too careless, and some are entirely unaware of their literary sins and short comings. The responsibility for their manuscripts appearing in the correct form must, therefore, depend upon the editors of these, and to these workers the first section of Mrs. Mellish's book will be particularly welcome and helpful. These same individuals will add fervent amens to the chapters in the second section, which deals with such subjects as the outline, length and arrangement of papers, their construction, the manuscript, biblographies, etc. The contents of this section are in such readable form that even the busiest man can quickly peruse them and profit thereby far out of proportion to the time so spent.

The author has well fulfilled her avowed purpose of providing a hand book especially adapted to the needs of medical writers and those who assist in the publication of medical literature. It includes, as she says, "the essential points to be found in general text books" and these are illuminated in many instances by telling quotations. To the initiated it is quite plain that much time, thought, study and experience has entered into the making of this little book; no one inexperienced in such work as that of this author could so well assemble the essentials for the mastery of what she calls "the craft of writing."

There are minor points here and there concerning which there may be a legitimate difference in tastes and opinions, but these are minor points and very few, and cannot be avoided in a publication of this kind.